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THE ANATOMICAL INSTRUCTOR;

OR,

An Illustration

OF THE

MODERN AND MOST APPROVED METHODS OF PREPARING AND PRESERVING THE DIFFERENT PARTS

OF THE

HUMAN BODY, AND OF QUADRUPEDS,

BY

INJECTION,
CORROSION,
MACERATION,
DISTENTION,
ARTICULATION,
MODELLING, &c.

WITH

A VARIETY OF COPPER-PLATES.

BY

THOMAS POLE,

MEMBER OF THE CORPORATION OF SURGEONS IN LONDON

Ad cædes hominum prisca Amphitheatra Patebant: ut longum discant vivere, nostra patent.
Inscrip. on Anat. Theatre at Paris.

A NEW EDITION WITH ADDITIONAL NOTES.

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BY

THEIR FRIEND,

THE AUTHOR.

PREFACE.

ANATOMY being the foundation of that noble superstructure, the Healing Art, must surely be considered as a branch of science, claiming superior attention from the philosopher and natural historian. Prompted by this sentiment, I have undertaken a work, which, in its effects, may operate most usefully on medicine; to the true practice of which, no one will dispute its being an essential requisite, as on an accurate knowledge of the structure and use of each part of the body, a true therapeia can only be formed. To Surgery it is more immediately subservient; it being rational to conclude, that independent of anatomical knowledge, operations must be not merely ambiguous in their success, but, frequently, fatal to the patient.

To the art of Farriery, hitherto, for the most part, in the hands of the lowest and least informed of mankind, a treatise of this kind may be singularly useful; as any means which will facilitate the acquisition of the knowledge of quadrupeds, will highly benefit the human species, more particularly by rendering an essential service to that noble and useful animal, the Horse, whose diseases being now treated by the hands of ignorance, would more frequently prove fatal, had not an all-wise Providence happily furnished the animate body with power, not only to counteract deleterious remedies, but frequently, without foreign assistance, to effect a cure.

By the gentleman, Anatomy ought to be considered as a branch of education, no less necessary to form the accomplished character, than any other department of philosophy: it not only being to him an ornament, and, if a true speculatist, an amusement, but also enables him to determine, when the means which are usually employed for the cure of diseases, even in the brute creation, are consonant to reason and sound sense: a faculty of some consequence, in an age when the breed of horses is not thought unworthy the attention of men eminent as to station and abilities.

It is, however, to be regretted, that a department of natural knowledge, so replete with advantages to every species of animal, should languish, for want of proper opportunities of engaging in it with that ardour, by which alone a due and necessary information can be procured. In the capitals of most kingdoms it is admitted, that anatomical objects are more easily obtained, and it may therefore be presumed, that at least among those who profess to heal, this science is more frequently and extensively cultivated: but even by them, from the dangers and difficulties with which bodies are procured, an accurate knowledge of minute Anatomy is rarely attained.

To the inhabitants of the country such a portion only is imparted, as a few months residence near the theatres of dissection can furnish them with; private anatomical investigation of the human, is with them too difficult and dangerous, to tempt even the hardiest to engage in: the inspection of morbid bodies seldom, if ever, falls under their notice; and, supposing this to sometimes occur, it is, in general, so cursory, as to add but little to their stock of anatomical facts. Hitherto, the pupil has experienced difficulties in prosecuting the anatomical part of his education, by being precluded from acquiring a knowledge of the different modes of preparing such parts of the body as would serve, not only, to impress his mind more forcibly with their structure and true use, while in preparation, but would be to him a memento to which he could always refer, when distantly removed. On a subject so undoubtedly necessary, nothing has hitherto been published; excepting the paper in the Edinburgh Medical Essays, on the subject of Injections, by the late truly ingenious Doctor Monro; and what has been done by John Sheldon, in his History of the Absorbent System, Chap. I. who treats only of that part of the subject which respects "*The method* "*of discovering, injecting, dissecting, and pre*"*paring the Absorbent Vessels;*" and to which I may refer my readers for some useful hints in this particular branch of practical Anatomy: nothing, however, systematic, or, in any degree comprising extensive and substantial information, such as the Tryo will require, has yet been offered to anatomical students.

A sedulous attention, persevering industry, and a love of science, should be the invariable characteristics of an anatomical genius: possessed of these, he cannot fail to acquire such proficiency as will render him an ornament to society, and, in medicine, highly useful to the country which he may favour by his residence. To such the lectures of our theatres, now delivered by men of the first abilities, as Anatomists, and Gentlemen, will afford ample gratification. By incidental dissection and conversation on the business of the day, with others engaged in the same pursuits, he may indelibly imprint those subjects on his mind:

The design of this work is still further to assist his studies, by enabling him to make such preparations of the human body, when dissecting, as will hereafter be useful ornaments to his cabinet, and put it in his power to preserve the different parts of quadrupeds, whereby comparative Anatomy, hitherto much neglected, may be so cultivated, as to throw considerable light on the organization and physiology of the human.

To professed Anatomists it is not presumed to offer this treatise: their good sense will, however, admit its necessity, and, perhaps, their candour may induce them to add such hints as may, hereafter, authorise another and more complete edition. From men, hitherto, uninformed, it appears evident, and, perhaps, with some reason, that I expect encouragement; its utility to them will, I trust, warrant their good opinion. The difficulty of describing the mode by which every part is prepared, has directed me to select such only, as are of most importance, and from an acquaintance with which, every other will naturally occur. Those who wish to become complete Anatomists, I must urge to devote a sufficient time at the usual places of instruction; to them, I hope, this treatise will be found, what I mean it to be, an useful companion and assistant.

My subject has been arranged in the way that seemed to be plainest, and best adapted to communicate each process in the most complete and concise manner: it would appear, that beginning with the easiest mode of preparation should have been followed; but, each part requires a complicated treatment, such division was thought impracticable, at least inadequate to furnish the necessary information.

Numerous have been the difficulties which I have had to encounter in the prosecution of this work; being anxiously solicitous to avoid introducing any mode, which had not been previously submitted to the test of my own experience; practical engagements have, necessarily, interrupted that chain of attentive investigation so essential to my subject. The want of proper accommodation to perform my processes, has, not unfrequently, been a source of inconvenience, and the well-known expence of pursuing Anatomy is no inconsiderable obstacle to its improvement.

By an experience of my work's proving useful; by its promoting Medical and Chirurgical knowledge, I shall be amply gratified: with this view, therefore, I solicit the candour and attention of my readers

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THE
ANATOMICAL INSTRUCTOR.

COLOURED INJECTIONS.

ARTICLE I.

Composition and Qualities of Coloured Injections.

IT is, at all times, necessary that the composition, called Injection, should have certain properties to answer the purposes for which it is designed. In the first place, it should be liquified by a degree of heat less than the boiling point, that it may not destroy the texture of the vessels it is intended to fill; and, in the next place, it should become solid, when deprived of that heat, and reduced to the ordinary temperature of the atmosphere, yet not so solid but that it may be bent in every direction without breaking: these observations apply to Injection used for any other purpose than that of corroded preparations; for the coats of the vessels, when dry, give an additional strength to the body of Injection they contain; but in corroded preparations, the coats of the vessels, as well as the surrounding substance, being destroyed by the acid, a more solid Injection is required, otherwise the preparations, when finished, will not support their own weight, especially in warm weather, and thus the intention of the Anatomist will be defeated.

The several Injections* commonly used for anatomical purposes, are four in number, viz. coarse, fine, minute, and mercurial: the three first of which may be variously coloured, according to the inclination or purpose of the Anatomist:—for the composition of these, see the Formulæ. The coarse, is commonly

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* There is a composition for injection which is very easily made, and which has been used of late in the Dissecting Room of Windmill Street: it is made in the following manner.

Get, at the colour shops, a quantity of red lead, mixed up with linseed oil to a thicker consistence than it is generally used for painting, and made more of the consistence in which white lead is kept. To this mixture of red lead and oil, add turpentine varnish, until the composition is about the consistence of common thick oil; and also add a little spirits of turpentine, which makes it run better:—in this state the composition is injected. It is not possible to give, accurately, the proportions in which the different ingredients are to be mixed, as in the different shops the degree of fluidity of the turpentine varnish often varies; but the injection is so easily made, that there is no danger of going wrong:—immediately before injecting the composition, a little water should be sprinkled on it.

There is no necessity for heating the body, or the injection, which is the great convenience. This injection is, sometimes, some hours of hardening, but it always hardens in the course of a day.

An injection to run more minutely, may be made of the white lead, mixed with the turpentine varnish; this is merely owing to the white lead being better mixed up than the red commonly is. But it is possible to make the injection any colour, by adding the colour to the varnish, before the varnish is mixed with the white lead; though it requires a great proportion of colour to overcome the strong-white colour of the white lead.

Beside the advantage of this injection not requiring any heat in the preparation of it, it has also the advantage of not hardening so quickly as the wax injection; so if any accident occur used for entire subjects, or extremities, and all large vessels, where it is not necessary to fill the minute branches; the fine Injection is used to fill the smaller branches of the principal vessels, a portion of which is thrown in first, and, immediately after, followed by the coarse; which forces the former into the finer branches, and is more favourable for an elegant display of those, not too small to be exposed by dissection.

The two first compositions, by frequently being melted over the fire, lose a part of their fluidity, and the mass becomes too hard and brittle; it will, therefore, be necessary to add, discretionally, a little more turpentine varnish, which restores its flexibility. To judge when a sufficient quantity is added, a little of the Injection may be dropped into a vessel of cold water, and, when quite cold, it should be tried with the fingers whether it is then so flexible as to be bent repeatedly without breaking: this is the only criterion of its proper consistence.

The minute injection is for the purpose of filling the smallest ramifications of the vessels, to give the cutis, or other parts, their natural colour, or to shew their extreme vascularity; afterwards, these preparations

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during the injection, as the bursting of a vessel, there is plenty of time to tie the vessel, and to go on with the injection. After the vessels containing this composition have been dissected, they are much more durable filled with hot injection, as the degree of heat that destroys wax injections, has no effect upon the lead injection. It is thus particularly well adapted for preparations intended to be carried into a warm climate.

are to be preserved in spirits of wine, oil of turpentine, or by drying and varnishing, as hereafter described under their proper heads:—the necessary remarks on quicksilver, as a substance for injecting, will be given in their proper place.

Some have used tallow as the principal ingredient of Injection, on account of its fluidity and readiness to mix with a great variety of colours; but there are two material objections to it,—its brittleness, and its not retaining the colour given to it; on which account, it is now seldom, if ever, used for a coloured Injection.

The several colours, red, yellow, green, blue, black, and white, are, generally, employed in Injections; they should be perfectly opaque, specifically light, have great brightness, be unchanged by the inferior degrees of heat, and, during the liquefaction of the composition, have no disposition to froth. Though neither of these colours possess all the above qualities, yet they are the least exceptionable of any we are at present acquainted with.

No greater degree of heat should be applied to Injections than is just sufficient to give them their highest degree of fluidity, otherwise the colour will be changed, and the coats of the vessels injured.

All the coloured Injections should be melted in earthen pots,* and stirred with a wooden instrument, in shape of a marble pestle, by which the colouring powder may be prevented collecting into lumps; each pot should have an instrument of this kind, otherwise, by shifting the same from one colour to another, their beauty will be materially affected.

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* See page 17.

ARTICLE II.

General Observations on Injecting with Coloured Fluids.

THOUGH instructions may be given, to facilitate the acquisition of this art, yet they will be found insufficient for the dexterous performance of its operations; a moderate share of experience can alone remove the difficulties, which result from the want of it. The truth of these sentiments will be better understood by the young practical anatomist, after he has met with a few disappointments to his sanguine expectations, by the unexpected destruction of some preparations, which are the objects of his first experiments: for this he must prepare himself with an inflexible resolution and uniform patience.

In preparing for injecting any anatomical preparation, great care should be taken to have every thing in readiness, as the want of some one trifling thing will, now and then, frustrate the whole process, and, perhaps, ruin a valuable preparation. A proper quantity of hot water to thoroughly heat the preparation; a fire sufficient to melt the Injections of the several colours intended to be used; as large a quantity of

Injection prepared as will be necessary, and of proper consistence, are the circumstances first to be attended to. The syringe should be hot, but not so as to destroy the valves: the pipes should be previously cleared out, and securely fixed in the vessels.* Every thing being ready for the operation, the several pots of Injection are to be placed near the subject to be injected; an assistant should then hold the pipe thus fixed in the vessel, so that the operator may expeditiously introduce the point of his syringe, when filled with Injection, and always observing in filling the syringe, to put the point to the bottom of the pot, to avoid drawing in air; and it is best to fill and empty it once or twice before we proceed to inject; when filled, convey the point of it into the pipe held † by the assistant, then the operator should take the pipe between the fingers of his left hand, and depress the piston with his right, so as to force the fluid into the vessels with freedom, till they are nearly filled, which he will be sensible of, by an increasing resistance to its passage: and, lest the resistance should be in the syringe, he should move the piston by a screwing motion, when, sometimes, he will find, he may proceed a little further with safety; after a prudent force has been applied for a short time, he is to remove his syringe, and force the remaining Injection into the pot he took it from, and the assistant should always be ready, immediately to stop the pipe with a cork, or plug made of tow, twisted into a proper form for the purpose, to prevent the return of the Injection from the vessel. If there are several vessels to be injected with different colours, as arteries, veins, excretory ducts, &c. the mode of injecting each, is similar to the first.

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* Before throwing in the injection be careful that it is not too hot, for too great a degree of heat will so corrugate and weaken the vessels, that they will be in danger of rupture. It is owing to this cause, that, during an injection, extravasation is generally occasioned by the rupture of the large vessels; for, before the injection reaches the smaller branches, its temperature is diminished. If the finger can be held in the injection, there is no danger of rupturing the arteries from too great a degree of heat.

† Before putting the syringe into the pipe, hold up the nozzle, and press the piston till the injection appears; by doing this, all air is prevented from going in with the injection.

It is impossible to ascertain the exact force, with which the piston of the syringe should be pressed in the act of injecting; it varying greatly, under different circumstances; the force which is requisite to inject some vessels, would rupture and destroy others. Arteries, in general, will sustain greater pressure than veins, and either of them will sustain less if they are weakened by any degree of putrefaction.

When a large system of vessels is to be injected * by a large pipe, the Injection may be thrown in boldly at

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* It is almost quite needless to attempt to inject an old subject so minutely, as to make it worth the trouble of dissecting it, with the degree of care that is necessary in making preparations; for the arteries are generally so unelastic and brittle from ossification, that extravasation almost always happens in some of the vessels. A subject intended for a preparation ought to be young, and free from fat. The arteries of a young body are strong and elastic, which enables them to bear a much greater push of the injection, and, when full, give warning by an elastic

first, but when there is reason to expect, that it is nearly filled, the piston should be moved with greater caution, and the resistance afforded to the passage of the fluid carefully attended to, or else the vessels will probably be ruptured; when this happens, the operator is sensible of it by the feel; for the resistance to the passage of the Injection, is immediately taken off, and the fluid passes with the greatest facility; it then will be in vain making any further attempt to fill the vessels, unless such rupture happens where the part may be secured by the finger and thumb of an assistant, or by a ligature, unless it is very small, or happens in a part where but little of the Injection can escape. Another inconvenience may arise from the vessels being over distended, even where no rupture happens, more especially in the arteries, which though it is not of equal importance with the former, will be better avoided; that is, when they are thus preternaturally distended, they become elongated, and thrown into a serpentine form, which is apt to give a wrong idea of their natural appearance.

When injecting through a very small pipe, the Injection will pass proportionably slow, as the resistance to the passage of the fluid will, of course, be greater; this resistance, from not considering the cause, has been supposed by some, not much experienced in the art, to be owing to an entire obstruction in the pipe,

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resistance, which is never felt in injecting the arteries of an old body; for in them there is a sudden opposition to the flow of the injection, and if the injection is attempted to be pushed farther after this, the artery will certainly be ruptured.

and thence they have desisted from forcing the piston, whilst the Injection was passing with as much freedom as the pipe would admit, and only required a little more time to fill the vessels completely, and this circumstance should always be kept in remembrance, when small pipes are used.

If the part to be prepared is bulky, * and the vessels not so superficial as to be easily chilled, as entire subjects, large extremities, &c. it may be taken out of the hot water, and laid on a table, or in a dish; but if it is thin and membranous, or the vessels pass near the surface, the contact of cold air, or the coldness of the table, &c. on which it is laid, would be in danger of chilling the Injection in its passage, and greatly injure the preparation, and therefore should always be injected in hot water.

EXPLANATION OF PLATE I:

Representing the Brass Syringe, with its several Appendages, for injecting with Coloured Fluids.

Fig. 1. The syringe complete, consisting of several parts, supposed to be properly joined and fitted for use, viz.

A. The barrel.
B. The piston.

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* If the tub in which the body is heated, be large enough to allow of the body being injected while in the water, it ought never to be lifted out of the hot water until the injection is finished, as the success of the injection depends greatly on the body being kept always hot.

C. The head of the syringe, which screws on to the top of the barrel.

D. The bottom of the syringe, which screws on to the bottom of the barrel, in like manner with the head.

E. The point of the syringe, which screws into the bottom; this is a tube, to which the bore of all the pipes are adapted, and in the act of Injecting, it is introduced into the pipe.

Fig. 2. The piston of the syringe, taken out of the barrel, to shew its several parts, viz.

F. The handle.

G. The rod.

H. The bottom, consisting of three blocks, united to the rod by a screw.

I. The uppermost block with a plain edge.

K. The middle block has a grooved edge, is of a larger diameter than the other two, and is adapted to the bore of the barrel of the syringe; its groove is for the purpose of retaining oil, as a reservoir to preserve the free motion of the piston.

L. The lowest block, similar to the uppermost, and of the same diameter, having in its lower surface two small holes, to receive the steel pins in the key, for the purpose of screwing it on or off the rod. The uppermost and lowest blocks are less in diameter, to allow room for the two valves.

Fig. 3. Represents the bottom of the piston with the valves, which are made of circular pieces of soft wash-leather, dipped in olive oil, with a hole in the centre, through which passes the end of the rod. The manner of fixing which is as follows:—First, screw on the uppermost block on the rod, as far as it will go; then put on one of the leather valves, consisting of one or more pieces of leather, as the bore of the syringe may require; then screw on the middle block, after which introduce the piston at the top of the open barrel of the syringe, with the edges of the valves turned towards the handle; then force the piston to the bottom, which, being also open, gives an opportunity to put on the lower valve, which is to be confined in its situation by firmly screwing on the lowermost block by means of the key; the edges of this valve should not be left longer than necessary, as it will prevent the lower block of the piston from going completely down upon the bottom of the syringe, which would be a means of retaining some of the Injection, and thereby mixing the different colours. Being thus fixed, draw the piston upward, by which the edges of the lower valve will be turned downward; then screw on the bottom and top of the syringe very closely by means of the key; and after moving the piston a few times up and down in the barrel, try the accuracy of the valves in the following way:—first, hold the bottom of the syringe with the left hand, and stop the point with the fore finger, to prevent the admission of air; then with the right hand draw the piston up to the top, and suddenly let go the handle, when the external air should press the piston completely to the bottom; this is a sufficient proof that the upper valve is air-tight; then fill the syringe with air by drawing the piston to the top, while the point is open for its admission; place the finger on the point to prevent its escape, and forcibly depress the piston; then suddenly taking off the hand, the elasticity of the compressed air should raise it to the top, making some little allowance for the resistance which may arise from the friction of the piston in the barrel: this is a proof that the lower valve is sufficiently air-tight, and the instrument fit for use.*

Fig. 4. The brass key, which is made of considerable thickness to give it strength; it has a square notch in each end, the larger of which is adapted to receive the square block on the top, and bottom of the syringe (MM).—The smaller notch is intended to receive the smaller block in the bottom of the syringe (N).—This key answers the pupose of a winch, by which we may easily apply what force is necessary to turn the screws. At the extremities of the smaller end of the key, are two steel pins; these are adapted to two holes in the bottom of the lower block of the piston, into which they are placed, for the more readily screwing it on or off in altering and repairing the valves.

Fig. 5. A cock, for the purpose of retaining in the blood-vessels, the Injection they have received, whilst the syringe is removed, in case of injecting a large subject, where several syringes full will be required; the smaller and lower extremity (O) is inserted into the top of the injecting pipe when fixed in the vessel, represented in *fig.* 11, and for the purpose of throwing in the Injection, the point of the syringe is to be introduced into the upper end of the tube of the cock (P), and when the syringe is discharged of its contents, turn the handle (Q) in a transverse direction to the tube, which will prevent the escape of the injected fluid, until the syringe is filled and introduced at the top as before; then turn the handle again, and repeat the Injection as often as may be requisite. The plug is fastened in its situation by means of a screw (R), for the purpose of taking it apart at any time, if found necessary, to clean or oil it.

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* Syringes of different sizes are very useful, particularly one which is called the Oyster Syringe, which is small enough to be managed entirely by the right hand, while the part to be injected is held by the left hand.

Fig. 6. An injecting pipe of the largest size, in proportion to the size of the syringe.

S. The finger piece.
T. The barrel.
V. The point.

These pipes should always be made of one solid piece of brass, and the finger piece not soldered on to the barrel as they will be liable to separate when the heat of the fire is applied to melt out the Injection, which, though it may be done in a hurry, yet should not be made a constant practice of; boiling them in water is a much more agreeable, and less destructive method of cleaning them. Near the extremity of the point is a small shoulder, to prevent its slipping out of the vessel when the ligature is applied.

Fig. 7. The smallest sized injecting pipe, with the barrel above the finger piece: this is the mode in which the small pipes are frequently made, but I do not know any peculiar advantage in it.

Fig. 8. A large sized curved pipe, commonly called Aorta-pipe, being principally used for injecting the entire subject, where it is introduced into the Aorta ascendens through an incision in the left ventricle of the heart. The advantage of its curvature is, that the extremity of the pipe pointing horizontally or laterally, it admits of a favourable position to introduce the point of the syringe.

Fig. 9. A double injecting curved pipe. The advantage of having two points, is in order to inject two vessels running near each other, at the same time, with the same coloured Injection, but they are seldom used except for injecting the head by the two carotid arteries, and the two jugulars; but, for the arteries, the points should be made smaller than is represented in the plate.

Fig. 10. A long curved pipe, for the purpose of injecting vessels, the orifices of which are out of the reach of the common pipes, as is the case with the coronary arteries and veins of the heart, where we have to convey the point of the pipe, a considerable distance through a larger vessel, to the vessel we wish to inject; and, as it is more particularly intended for this preparation, may be called the coronary pipe.

Fig. 11. Represents a pipe fixed in the vein of an umbilical chord,* to shew the manner in which the

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* In fixing the pipe into an artery, if the ligature be tied very tight, it will rupture the inner coat of the artery, which is often a cause of failure in the injection, from the wax pushing the torn inner coat before it, and forming a valvular obstruction.

Plate

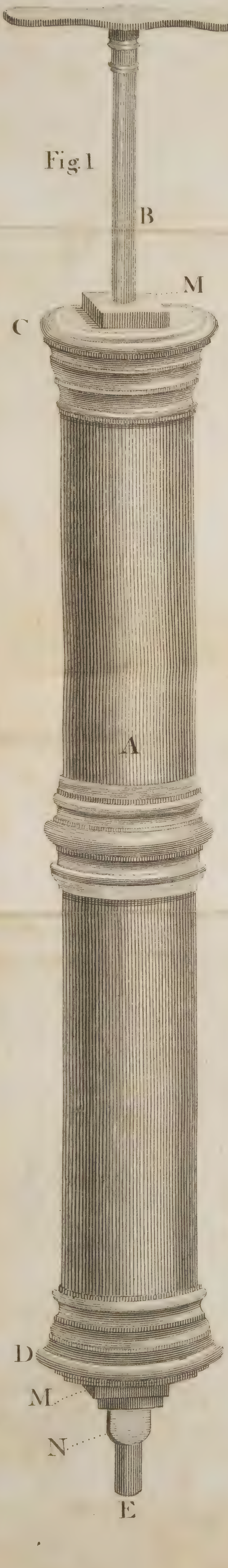
Fig. 1

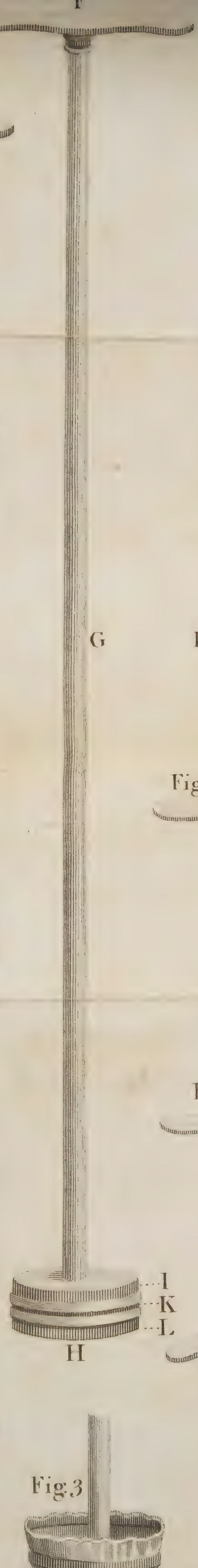
Fig. 2

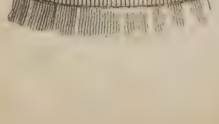
Fig. 3

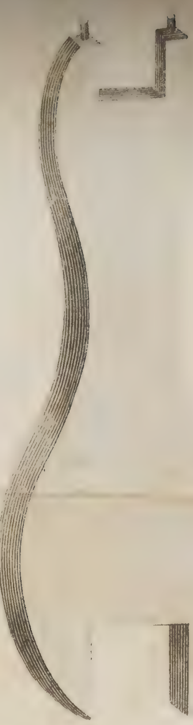
Fig. 4

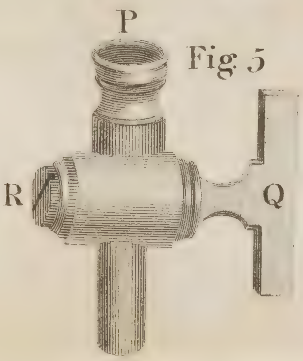
Fig. 5

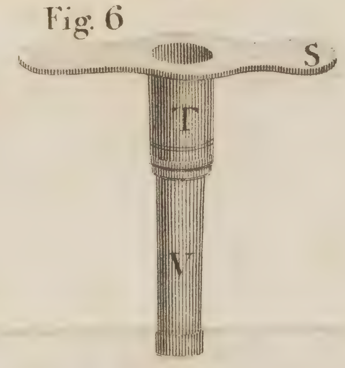
Fig. 6

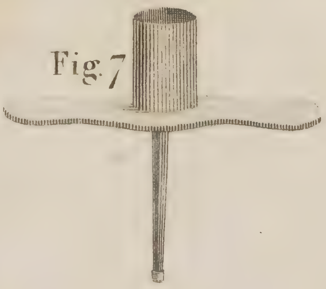
Fig. 7

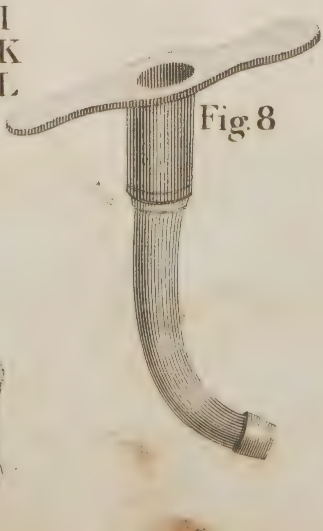
Fig. 8

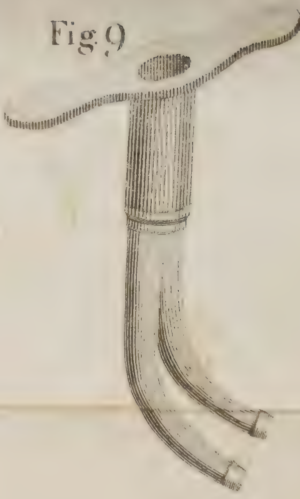
Fig. 9

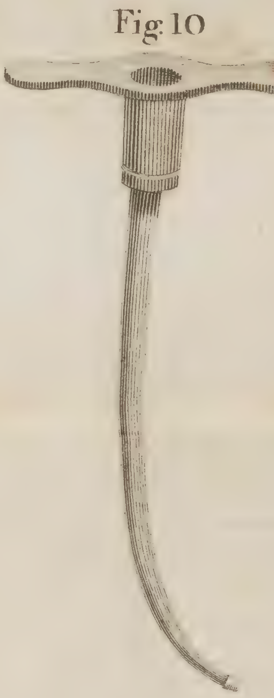
Fig. 10

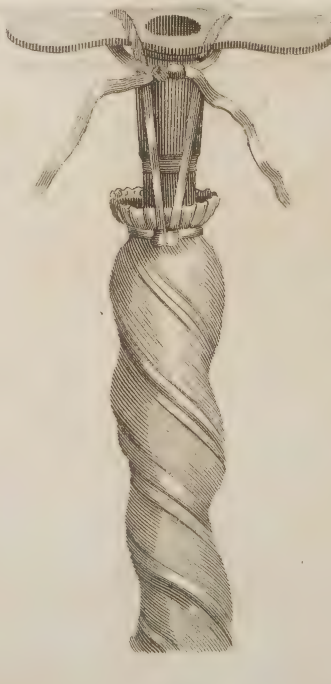
Fig. 11

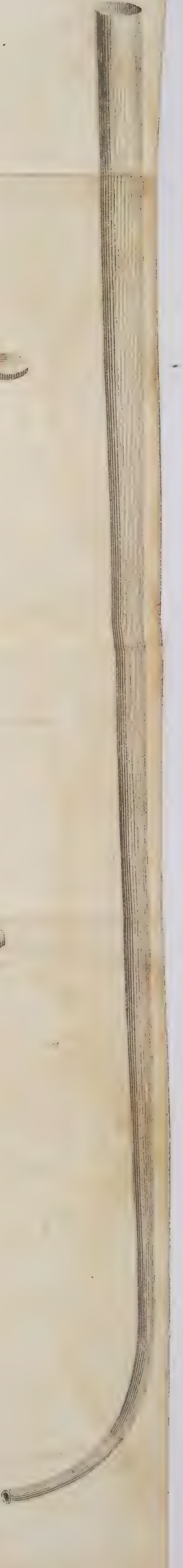
Fig. 12

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ligature is applied to prevent the escape of the Injection, and secure the pipe in its situation; if the ligature is not brought over the finger-piece of the pipe before the second fastening is made, as here represented, it will generally slip out of the vessel.*

Fig. 12. A brass blow pipe, sometimes used to inflate the vessels in order to find their orifices, which is frequently attended with difficulty from their lying perfectly collapsed among cellular membrane;† it will often be found useful to inflate the vessels of detached parts of Anatomy, to discover and secure any outlets where the Injection might otherwise escape; but these outlets will be more easily discovered if inflated under water, than any other way: the end of the pipe which is applied to the mouth should be silvered, to prevent any unpleasant brassy taste.

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[*] In introducing a pipe into a large vessel, as for example the Aorta, it ought to be wrapped round with lint, to make it fit more accurately to the calibre of the artery, as it often happens when injecting the Aorta by one of the largest pipes, that the injection escapes by the wrinkles made in the artery, when tied upon the pipe without any thing wrapped round it, as the calibre of the Aorta is so much larger than any of the pipes.

[†] It is a bad plan to blow into the vessel, before injecting, as it always makes the injection in the vessels appear cracked

ARTICLE III.

Formulæ for Coarse Injections.

RED.

YELLOW bees wax, sixteen ounces;
White resin,* eight ounces;
Turpentine varnish, six ounces;†
Vermillion,‡ three ounces.

First liquify the wax, resin and turpentine varnish over a slow fire, in an earthen pot; § then add the vermillion, previously mixing it in another pot, with a very small quantity of the liquified composition, and stirring it well with a wooden pestle, so that the colouring ingredients may be intimately and smoothly blended; then add, by degress, the whole of the ingredients, and when they have acquired their due heat, by being placed again over the fire, the Injection will be fit for immediate use.—These rules are to be observed in preparing all the following Injections.

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* What is here called white resin, may, with equal propriety, be called yellow; it is only intended to recommend the whitest that can be procured.

† The turpentine varnish is here always directed by measure, the other ingredients by weight.

‡ Carmine possesses more completely the qualities requisite for a colour of injection, than vermillion; but the price forbids its entering into these compositions.

§ In melting injection in earthen pots there is great danger of accidents from the injection boiling over, and the colours are also hurt by the heat being often too strong for them; to prevent this, the injection ought to be always melted in pans immersed

YELLOW.

Yellow bees wax, sixteen ounces;
White resin, eight ounces;
Turpentine varnish, six ounces;
King's yellow, two ounces and a half.

WHITE.

Fine white bees wax, sixteen ounces;
White resin, eight ounces;
Turpentine varnish, six ounces;
Best flake-white,* five ounces and a half.

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in hot water. Where many injections are made, the following plan, which is used in Windmill Street, will be found very useful, either in preventing accidents by fire, or the spoiling of the colours by too great a degree of heat, and in making a very material difference in the expence of fuel and saving of trouble.

Upon the boiler of a small still, to which a furnace is attached, a long pan is fixed and secured by luting. The pan has three or four sockets, in which are placed the small pans, containing the different coloured Injections. Into the opening (which is generally left in the boiler to pour in the liquor to be distilled) a leaden pipe is fixed, which is carried into the bottom of a large tub of water The steam playing in the large pan is sufficient to melt the injection, and the steam which escapes by the pipe heats the water, to warm the body which is to be injected.

* Flake-white, as usually sold in the shops, is very unfit for these purposes, being adulterated with starch, or common whiting.

PALE BLUE.

White bees wax, sixteen ounces;
White resin, eight ounces;
Turpentine varnish, six ounces;
Best flake white, three ounces and a half;
Fine blue smalt,[*] three ounces and a half.

DARK BLUE.

White bees wax, sixteen ounces;
White resin, eight ounces:
Turpentine varnish, six ounces;
Blue verditer, ten ounces and a half.

BLACK

Yellow bees wax, sixteen ounces;
White resin, eight ounces;
Turpentine varnish, six ounces;
Lamp-black,[†] one ounce.

GREEN.

Yellow bees wax, sixteen ounces;
White resin, eight ounces;

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[*] Fine blue smalt is sold in most colour-shops, under the name of powder blue, and in general sufficiently well prepared.

[†] Lamp-black has sometimes a quantity of sand mixed with it, to increase its weight, for the advantage of the seller; it should not be used in this state; or if it cannot be obtained pure, a little more than the proportion above ordered should be used, to allow for the deception which the sand occasions, in respect to weight; when the composition is prepared, let the sand subside, and pour off the pure part for use.

Turpentine varnish, six ounces;
Crystallized verdigrise,* four ounces and a half;
Best flake-white, one ounce and a half;
Gamboge, one ounce.

If a quantity of the ingredients of this Injection is kept prepared, without any colour, it will be more convenient for those who are in the frequent practice of making anatomical preparations; being readily separated into small quantities, the different colours may be added in their proper proportions, agreeable to the wish of the Anatomist.

The crystallized verdigrise and gamboge not being sold in the shops in a state of levigation, particular care should be taken that these are finely prepared; the other colours, recommended in this article, are generally sold in a state fit for the purpose.

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* Considerable caution should be used in mixing this ingredient with the liquified composition, to prevent its boiling over; the heat applied should be moderate, and the best method is to mix it with a small quantity of the composition, on a tile or marble slab, with a bolus knife; and the whole added gradually to the remainder of the composition, after which give it the requisite heat cautiously.

ARTICLE IV.

Formulæ for Fine Injections.

THE rules given for mixing the colours with the liquified composition, in the preceding article, are to be followed in every formula of this; and though the following ingredients are much more fluid than the former, they should, notwithstanding, possess the same degree of heat, that the Injection may pass into the capillary vessels with freedom, and not chill the coarse Injection which is immediately to follow it.

RED.

Brown spirit varnish, *
White spirit varnish, of each four ounces, †
Turpentine varnish, one ounce;
Vermillion, one ounce;

YELLOW.

Brown spirit varnish,
White spirit varnish, of each four ounces;
Turpentine varnish, one ounce;
King's yellow, one ounce and a quarter.

WHITE.

Brown spirit varnish,
White spirit varnish, of each four ounces;

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* The varnishes, mentioned in this article, are by measure.

† These varnishes are commonly sold in the colour-shops.

Turpentine varnish, one ounce;
Best flake-white, two ounces.

LIGHT BLUE.

Brown spirit varnish,
White spirit varnish, of each four ounces;
Turpentine varnish, one ounce;
Fine blue smalt, one ounce and a half;
Best flake-white, one ounce and a quarter.

DARK BLUE.

Brown spirit varnish,
White spirit varnish, of each four ounces;
Turpentine varnish, one ounce;
Blue verditer, four ounces.

BLACK.

Brown spirit varnish,
White spirit varnish, of each four ounces;
Turpentine varnish, one ounce;
Lamp-black, half an ounce.

The green Injection is omitted here, the verdigrise being a saline substance, will not mix with the spirit varnishes.

ARTICLE V.

Formulæ for Minute Injections.

THE Size which constitutes the principal part of these formulæ is made in the following manner.

Take the finest and most transparent glue, one pound, break it into pieces about the size of a nutmeg; put it into an earthen pot, and pour on it three pints of cold water, let it stand twenty-four hours; stirring it now and then with a stick; then set it over a slow fire for half an hour, or until all the pieces are perfectly dissolved; skim all the frothy part from the surface, and strain it through a fine canvas cloth, or, what is better, a flannel; it will then be fit for the addition of the colouring ingredients.

Some make their Injecting-size with Isinglass, but I am not acquainted with any advantages it has over the glue; excepting, that in the white Injection, it may admit of a greater delicacy of colour, but being much dearer, it is not so generally used as the glue. The cuttings of parchment also make a more delicate size than glue. These are merely mentioned for such who may choose to use them by way of experiment, or otherwise. Whichever is used, the quantity of the colouring ingredients should be in the same proportion.*

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* The size which is procured in the shops, under the name of pale double size, runs very minutely; it is very cheap, and requires no trouble in preparing it for injection.

RED.

Size, one pint;
Vermillion, three ounce and a half.

YELLOW.

Size, one pint;
King's yellow, two ounces and a half.

WHITE.

Size, one pint;
Best flake-white, three ounces and a half.

BLUE.

Size, one pint;
Fine blue smalt, six ounces.

GREEN.

Size, one pint;
Crystallized verdigrise, two ounces;
Best flake-white,
Gamboge, of each eight scruples.

BLACK.

Size, one pint;
Lamp black,* one ounce.

Dr. Monro advises spirits of turpentine as a minute injection, but the size will be found to succeed better in making minute preparations, to be preserved in spirits of wine.

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* The lamp-black should be moistened with a little spirits of wine, previous to its being mixed with the size, otherwise there

It may not be an useless redundancy, once more to say, how requisite it will be to take all possible care to have the colours well levigated for these Injections, as the success of every experiment made with them, depends principally upon this circumstance; and without such precaution, every purpose of the Anatomist will be defeated, even in the most experienced hands.

The minute Injection, in a moist state, will keep but a very little while;—in hot weather, not more than a few days; for which reason there should not be more made, at one time, than will be sufficient for the present purpose.

The only way to preserve it, is to suffer it to get perfectly cold, then cut it into slices of about half an inch in thickness, and dry it in a current of cold air: or it may be, whilst hot, poured into earthen plates to about the same thickness, and dried as before. It will be necessary previously to rub the plate with an oiled cloth, to prevent the Injection from sticking; when thus dried, it may be kept for any length of time; and to prepare it again for use, it is to be broken to pieces, and managed as directed in the first part of this article, for making the Injecting Size.

is some difficulty in mixing it; but much spirit will coagulate the size.

ARTICLE VI.

Injecting the Blood Vessels with Coloured Fluids.

THE Arteries having no valves, excepting where they make their exit from the heart, are very favourable for injecting; and as it seems to be the last act of life to contract these vessels, we always find them entirely emptied of the blood, and have the choice to inject them in what direction we please, either according to, or against, the course of circulation; but no doubt we shall prefer the former; from the larger, into the smaller branches.

Veins in general are unfavourable for injecting, on account of valves, which prevent any fluid passing in a direction contrary to the natural course of circulation, and in them are almost universal; therefore, we are under the necessity of injecting from the smaller vessels, which, consequently, cannot be less than will admit the smallest pipe: on this account we are prevented making so minute and beautiful an Injection of the veins as may be made of the arteries. Yet this inconvenience does not exist in all parts of the body, for some veins, having no valves, admit as minute and beautiful a display as the arteries.—Amongst these may be ranked the Uterus, Kidneys, Liver, Lungs, Spleen, Pancreas, Mesentery, Coronary Veins on the surface of the heart, the internal veins of the head, Placenta;—in short, all the Thoracic and Abdominal Viscera, are without Valves.

As the Veins are always more or less obstructed by the blood impelled into them from the arteries in the last functions of life, they should be washed out by injecting warm water several times through them; this may be conveniently done in extremities separated from the trunk of the body, where the largest part of the vein is cut off, and forms a free out-let to the water; but, where it can have no such exit, it cannot be conveniently done.

In some instances, the minute injection thrown into the arteries,* will return freely by the veins; and where this happens, they will, of course, be as minutely injected as the arteries.

In injecting with quicksilver, this circumstance more frequently happens, an instance of which is seen in filling the vessels of the hand.†

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* In injecting the arteries of the head with tallow, coloured with vermillion, the communication between the arteries and veins of the Pia Mater, will allow the tallow to pass, but not the vermillion, and in this way we see the arteries red, and the veins white.

† See the article upon injecting the hand with quicksilver.

ARTICLE VII.

Injecting, Dissecting, &c. an entire Subject, to trace and exhibit the Arteries.

FOR this purpose, adult subjects are seldom used, on account of the difficulty in completely filling the vessels with Injection; the time and labour that is necessary to dissect and prepare them; the length of time they would take in drying; the proportionate hazard of their being injured by putrefaction; the expence which attends the injecting, varnishing, and casing them, when finished; the inconvenience of handling and turning about so large a subject, to inspect the course of vessels on future occasions, &c. Therefore, the bodies chosen for what are generally termed blood-vessel subjects, are, from the earliest infancy, to about the age of fourteen years; and a thin emaciated subject should always be preferred, as it takes much less labour in the dissection, and does not retain, when dry, any of that disagreeable greasiness on the surface which is so frequent where there is much adeps, as we commonly find under the cutis of children. If the subject is anasarcous, the cellular membrane will dry with greater transparency, and hence is favourable for this purpose.

To inject the whole arterial system, there must first be made an incision through the integuments, the whole length of the sternum, then with a saw divide the sternum longitudinally into two equal parts; introduce a dissecting knife under the divided bone on each side, separate it from the mediastinum, and lay open the thorax, by bending back the two portions of the sternum and cartilages; an incision is to be then made into the pericardium and left ventricle of the heart, through the latter of these the curved, or aorta pipe (see Plate I. Fig. 8) is to be introduced into the aorta ascendens, and secured by a ligature made on the vessel (see Plate I. Fig. 11); then proceed to heat the body by immersing it in hot water, which requires about three or four hours, and inject according to the rules prescribed in Article II. When the vessels are injected, lay the body in cold water, with the face downwards; the intention of this is, that the Injection should be chilled as soon as possible, to prevent the colouring matter from subsiding partially to the sides of the vessels, and that if the Injection should remain long enough in a fluid state, the colour may be deposited in the anterior part of the vessels.

The next part of the process is the dissection, and the usual method of conducting it, is first to open the abdomen, from the incision already made in the thorax, longitudinally to the pubis; then remove the abdominal and thoracic viscera in the following manner:—The stomach and intestines, by cutting the mesentery close to the latter, so as to leave the mesenteric arteries as long as possible; the liver is to be next carefully dissected away, leaving as many of the ramifications of the hepatic artery as may be conveniently done; and the kidneys may be removed in the same way, though sometimes they are dried entire in the subject; the spleen will, of course, be removed with the stomach; all the vessels left in the abdomen should be carefully freed from the surrounding cellular membrane, adeps, and peritoneum, that they may be rendered as visible as possible. The urinary bladder is sometimes (more particularly in the male) inflated and preserved in its natural situation; the rectum, cellular membrane, &c. should be removed from the pelvis, and the internal pudendal artery (of consequence, in the operation of Lithotomy) brought into view, running on the inner side of the branch of the ischium. Care should be taken in dissecting abdominal viscera, to preserve the spermatic arteries, a very slender vessel coming off from the aorta, in general, a little below the emulgents, and are continued downward, through the abdominal ring to the testes. In the female they run to the broad ligaments of the uterus. The thoracic viscera will be removed with much less difficulty and labour than the abdominal, as this cavity contains only the heart, lungs, and œsophagus. The heart and lungs, in the common way of fixing the pipe, receive no Injection, and are therefore to be entirely removed, as also the œsophagus.* The same idea is to be pursued in clearing the thoracic vessels as the abdominal, to render them as conspicuous as possible; and to free the intercostal vessels from the obscurity occasioned by the surrounding adeps and pleura; these should be entirely stripped off.

The divided sternum is usually bent back on each side, to shew the internal mammary arteries, coming off from the subclavians; for this purpose, the cartilages of the ribs should be cut partly through on the inside, to suffer the sternum to lay back as described. The subclavians, carotids, &c. going off from the arch of the aorta, should be distinctly seen, and their ramifications traced over the head ; in doing which great care, time, and patience, are necessary to make a good preparation. The cutis should be carefully raised, making it an invariable rule, never to raise more on this, or any other part of the body, than, from time to time, may be necessary for carrying on the dissection, otherwise, the parts exposed to the air will become dry, and difficult of dissection. In removing the cutis, great care should be taken to keep the edge of the knife close to its inner surface.

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* The heart and pulmonary vessels injected and preserved in situ, will be the subject of another article.

In dissecting the blood vessels, they will sufficiently guide the dissector, if he traces them from the larger branches to their ramifications: to point out the course and situation of each, would far exceed the plan proposed, and be an useless enlargement. The dissecting scissars and forceps are the instruments, with which most of this part of the dissection is performed, after the cutis is raised. The cheeks and lips should be kept in their natural form by placing inside of the mouth a little tow or wool. In the next place, the extremities, are to be dissected ;—first, the arm by raising the integuments as before mentioned, and tracing the vessels from the axilla to the extremities of the fingers ; and in the lower extremities, from the groin to the toes ; separating and raising the muscles carefully from each other, freeing the surfaces of them every where from the adeps and cellular membrane, but not to separate any of them from their attachments ;

except in some parts of the body, where the course of the vessels cannot be exhibited without it; as on one side of the neck, sterno mastoideus, and other muscles, passing over the carotid artery and transverse processes of the vertebræ, may be removed, and the cervical artery traced from the subclavian, through the processes to the occiput. The pectoral muscles should also be raised from the thorax, and turned back, to shew the axillary vessels and external mammaries. The glutæi muscles should be elevated or partly removed, to shew some large branches going into them from the internal iliacs.—The cutis being removed from the posterior part of the trunk, the mucles on each side of the spinous processes of the dorsal and lumbar vertebræ are to be taken away, without any regard to order of dissecting, as it is merely to reduce the thickness of the part, and promote its drying in a less space of time, so as to avoid putrefaction. The brain may be removed by an opening made in the cranium, as hereafter described in the article for injecting and preparing the head for the blood vessels.

The dissection being finished, the next circumstance to be attended to, is the suspending the body (which should be done by a cord from the summit of the cranium through a hole made for the purpose) in some situation where there is a free current of cool air. The muscles are then to be separated to a moderate distance from each other, and supported by small pieces of wood, in a situation which may be best adapted to shew the course of the vessels;—the great object of the preparation. The thorax and abdomen are in a like manner to be kept open; in thus separating the muscles, thorax, and abdomen, regard should be had to the natural figure and situation of parts, not to distort them more than is necessary to shew the vessels. The mesenteric and other arteries entering the abdominal viscera, are to be placed in proper positions.* The legs and arms are to be put in such points of view as are most favorable for shewing the arteries of consequence in operations, or which we may wish frequently to inspect. The attitude most favorable for this purpose, and which occupies the least room, (a circumstance desirable to hospital students, who frequently convey preparations in cases to remote parts of the country) is to elevate one arm with the hand over the head, the palm inclining forward; this position is most favorable for shewing the axillary vessels, as well as the brachial, ulnar, radial, &c. The other arm may hang perpendicularly, with the palm directly forward. The inferior extremities may be suffered to remain in their natural situation, as no benefit can be derived from so unnatural a separation as is commonly given them; neither is there any advantage in separating the fingers and toes in so disagreeable a manner as many do.

Whilst these preparations are drying, they should be frequently attended to, to keep the parts in their proper positions. If, through unfavorable weather for drying, or by the subject having been long under dissection, putrefaction should take place, and a dark coloured clammy mucus exude from the surface of the muscles, it may be washed off with soap-lees and a soft painter's brush. When the preparation is perfectly dry, it should be varnished without delay.

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* The mesenteric vessels should be spread out on a piece of pasteboard.

ARTICLE VIII.

Injecting and Preparing the Head for the Blood-Vessels, &c.

THE head being separated from the body, by a transverse section, about the sixth or seventh vertebræ, the injecting it, is a simple and easy operation; for this purpose, a pipe should be fixed in each carotid artery; or a double pipe may be used on this occasion to throw the Injection into both at the same time. The jugular veins are also to be filled in like manner. The cervical arteries and vein should be secured by ligatures, to prevent the escape of injection.*

The arteries and veins are to be injected with different colours; for the former, red is usually employed; and for the latter, yellow. The dissection is to be performed according to the rules laid down in the preceding article. It will be necessary to remove, with a fine saw, a portion of the jaw bone, to shew the course of the internal carotids; the section may be made immediately posterior to the last dens molaris; and on the same side, the muscles, &c. should be dissected away between the transverse processes of the cervical vertebræ, to shew the course of the cervical artery ascending perpendicularly through them; on the other side of the head, the muscles should only be raised, and cleared from all the surrounding adeps and cellular membrane; and so placed, as may best show the course of all the vessels.

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* The best way of securing these vessels is to secure each of the vertebral arteries by a ligature, and after introducing probes into the carotids, to prevent their being compressed, to twist a cord round the vertebræ, including all the muscles of the back of the neck; then pass a strong ligature round the trachea, which will secure the vessels on the fore part of the throat.

The external parts of the head being finished, various sections may be made about the summit of the cranium to exhibit vessels, sinuses, membranes, &c. of the internal part, according to the intention of the anatomist: this is to be done with a saw, except the membranes, which may be divided by a knife or scissars. Sometimes a perpendicular section is made about half an inch to the right, or left of the sagittal suture, and carried down to within about an inch of the orbit, anteriorly, and as far as the lambdoidal suture, posteriorly; then the saw passed horizontally through the upper edge of the temporal bone, so as to meet the extremities of the first section, by which an elliptic portion of the cranium will be removed; sometimes it is made on each side the sagittal suture, by which the sinuses and processes of the dura-mater, &c. will be seen in their natural situation when the brain is carefully washed away, being first cautiously broke down with the fingers. Sometimes a horizontal section is made through the whole summit of the cranium. But as useful a section as can be made to shew the internal parts, is perpendicularly through the whole head and cervical vertebræ, beginning about a quarter of an inch on one side of the sagittal suture, just so as to escape the longitudinal sinus. and septum nasum; then incline the saw toward the centre of the foramen magnum, and through the middle of the vertebræ. The frontal sinus may be laid open, by removing a portion of the external table with a small trephine. If the preparation is made merely for the external vessels, then no section is required, and the brain may be extracted, in the following way;—make one or two perforations with a trephine, any where in the posterior part of the cranium; break down the texture of the brain with a stick, extract a small part, then pour in water, and stir it about so as to mix it with the brain, which will easily wash away; the putting in of a few large shot with the water, and shaking them about, in the manner of washing bottles, will greatly assist in destroying the brain, and cleansing the part.

ARTICLE IX.

Injecting Extremities for tracing by Dissection, and exhibiting the Blood-Vessels.

THE superior extremities are to be removed from the trunk of the body;* by raising the clavicle from the sternum, and passing the knife under it to the articulation, including the greater part of the pectoral muscle; thence dissect under the scapula, so as to remove with the arm, the clavicle, scapula, and subscapularis muscle. The Injection is to be performed by fixing a pipe in the axillary artery, which is divided in separating the arm from the thorax; and another in either of the veins on the back of the hand; some choose to put a second pipe into another of these veins, always as near the fingers as possible. The veins should be washed out with water; the Injection is to be effected according to the general rules laid down in Article II. and at the time of the operation, an assistant should stand ready to stop the Injection, as it flows out of the axillary vein, either by a loose ligature previously placed round the vessel, or by pressure.

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* It is much better to inject the superior extremities while attached to the body, from the subclavian artery where it is passing from under the clavicle, as in cutting off the arm so many small arteries are divided, that it becomes very difficult to secure them all.

The lower extremities are to be separated from the body,* by first removing the contents of the abdomen, or, at least, opening its cavity, so as to afford an opportunity to hold the intestines, &c. out of the way of the knife; then make a section through the symphisis pubis, and the ligaments, connecting the illium and sacrum, so as to remove with each, one side of the pelvis. The pipes for the purpose of Injection, are to be fixed, one in the iliac artery, and the other in one of the veins of sufficient size, any where about the foot, and as near as possible to the toes. The dissecting, drying, varnishing, &c. are described in their proper Articles.

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* It is much better to inject the limbs while attached to the body.

ARTICLE X.

Injecting the Blood-Vessels of the Gravid Uterus, and Preserving the Preparation in Spirits.

THE Gravid Uterus may be Injected either in its natural situation, or after it is removed from the body. In the first, the process of injecting will be the same as for the arteries and veins of an entire subject; but, as it is not always desirable to inject the whole subject, the uterus alone being the object of experiment, the Injection may run partially, by fixing the pipe for the arteries in the trunk of the aorta, or, what will be still better,* in the spermatic arteries, generally coming off from the aorta, below the emulgents, and entering the broad ligaments on each side of the uterus; and one in each hypogastric artery, entering just above the cervix uteri. For the veins, one is to be placed in each of the spermatic veins, accompanying the spermatic arteries, and another in each of the hypogastric veins, accompanying the hypogastric arteries, on each side. The arteries may be filled with red, and the veins with yellow. If the part is removed from the body, before any Injection is thrown in, all the divided vessels should be secured by ligature, to prevent its escape. An attention to this part of the process is particularly necessary in these preparations, the vessels being numerous and large. The branches of the hypogastrics distributed on the vagina, will require peculiar care. The preparation being injected, the surrounding cellular membrane and adeps may be dissected away, to render the vessels as conspicuous as possible. The ligamentum rotundum may also be dissected, to shew the arteries and a vein running through it in a beautifully convoluted direction.

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* Since the printing of the preceding page, I have considered the impropriety of injecting the uterus by the aorta; not from a want of a natural communication of vessels, but the distance the injection would have to pass, by which its force would be too much diminished, to fill the uterine vessels with tolerable minuteness.

The further proceeding with the dissection will vary according to the kind of preparation it is intended for:—if for a wet preparation, to shew the position, &c. of the child in utero, an oval portion of the uterus should be removed opposite to that part where the placenta is attached, which may always be known by the group of large vessels externally visible; this section should be sufficiently large to give a full view of the fœtus, when a corresponding portion of the chorion and amnion is also removed; the liquor amnii is to be poured off, and the fœtus carefully cleansed of the sebaceous substance deposited on the skin; then lay the preparation in water for a few days, changing it daily until the bloody colour is thoroughly extracted; then place it in a vessel upon its side, with the open part of the uterus upward, and the fœtus in its most natural position; in this situation pour on a sufficient quantity of spirits of wine to cover it; let it lay about eight or ten days to harden, after which it may be placed in a glass jar with clean spirits, properly suspended, with the fundus uteri upward and enclosed as usual. The various little circumstances in regard to the dissection which necessarily follow, may vary according to the purpose of the Anatomist; though not easily described, yet little or no difficulty will be found in supplying this deficiency.

ARTICLE XI.

Injecting and preparing Placentæ.

THE injecting a single Placenta is the most simple process of this kind of preparation.

They generally have only one vein, and two arteries in the umbilical chord; but sometimes more, as two veins and four arteries; the veins are always so large as to admit with ease a pipe of almost any size; the arteries are much less, and require pipes nearly of the smallest size; and some difficulty attends their introduction, by these vessels so contracting, as to greatly lessen their diameter, as well as from the lubricity of the gelatinous matter which surrounds them; but this difficulty is in a great measure avoided, by introducing the point of a dissecting scissars, and slitting them down for about half an inch; then spreading the artery open upon the left fore finger, and keeping it so by pressure with the thumb, by which the pipe may be carried in without difficulty;—a ligature should be passed round each pipe with a needle, and secured, as shewn in Plate I. Fig. 21. but considerable care is required in doing this, not to puncture the vessels, as thereby the Injection would escape; to avoid this, I have only fixed a pipe into each artery, frequently separated to a considerable distance by the interposition of the vein, which in this case I have not regarded puncturing; I thus have first injected the arteries, and then by putting a pipe into the vein, and making the ligature below where the needle had probably wounded it, have injected it afterwards. It will generally be found unnecessary to inject by both, or all the arteries, as the anastomosing branches form such a communication, as to admit the Injection thrown into one artery to readily fill the other; yet it is always proper to have two pipes fixed, in case they should not thus communicate, or any other accident should happen to one, that recource may be had to the other; whilst injecting by one artery, the pipe in the other should remain open until the Injection flows through it, and then immediately stopped by an assistant, yet so as not to interrupt the operation. The veins are most commonly in this, as well as in other preparations, injected with yellow, and the arteries with red. The vessels should always be previously washed, by injecting them several times with warm water; and a placenta for this purpose should always be entire, both with respect to the membranes and the fleshy part. The knots or coils frequently found in the funis, will not obstruct the Injection.

The injecting double and other placentæ is done in the same manner, in respect to the process; but a greater number of colours are required for distinguishing the ramifications of the several vessels from each other.

The parenchyma, or fleshy parts, are then to be carefully dissected from the vessels by the scissars and forceps. The gelatinous matter that surrounds the vessels in the umbilical chord will always dry transparent, and need never be removed: the rough external membrane, or tunica decidua, should be carefully peeled off from the other membranes, to render them more beautiful when dried. The preparation should then be macerated in water for about twenty-four hours, to cleanse it from all the blood; after which the membranes are to be carefully filled with wool, previously oiled, to prevent its sticking to the preparation; in doing which, care should be taken to put a sufficient quantity under the umbilical chord, to keep it at a considerable distance from the membranes; the chord should be coiled round the placenta within the membranes, imitating its position in utero; and the whole membranes distended so as to resemble the form of the ovum. It often happens that the membranes are rent in various directions, so as to injure the preparation: this circumstance (though it ought always to be guarded against) may be remedied, by spreading out their edges, and laying them over each other, so as to pin them together. After being distended, it should be placed upon a cloth in a current of air, to dry as soon as possible, when the pins are to be carefully removed. The external membranes will very soon lose their moisture; but the funis, containing a much larger quantity, in proportion to its surface, and being deprived of the circulating air by the surrounding wool, not so soon; in order to hasten it, when the membranes are dried, a part of the wool may be removed to admit the air to the inside, taking great care not to tear them, which is much more easily done now, than in their wet state. To finish the preparation, nothing more is necessary than to give it two coats of varnish on each side, to increase its strength and transparency, and when well managed, it is one of the most beautiful that is made, and should be defended from injuries by being kept in a glass case.

ARTICLE XII.

A dry Preparation of the Gravid Uterus, with or without the Blood Vessels injected.

A Dry preparation of the Gravid Uterus,* and its appendages, may be made with or without the blood-vessels injected; it is not very common, unless among the teachers of Anatomy or Midwifery. The uninjected uterus is easily prepared, when removed from the body with the Fallopian tubes, ovaria, vagina, external labia, &c. First dissect away the surrounding adeps and cellular membrane, make a simple incision longitudinally in the body of the uterus, and remove the whole ovum: then extract the bloody colour by maceration in water; afterwards fill the body of the uterus as full as possible with curled hair,* and sew up the divided parts; the vagina should also be distended in the same way, but the Fallopian tubes with cotton, which, on account of their smallness, require a softer material. The preparation should be suspended, or placed in the most natural position, in order for drying, and when completed, the hair and cotton being previously removed, it is to be done over with oil varnish.

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* The uterus of a woman dying from flooding, may be preserved in some degree in its natural shape, and the vessels of it injected by the following method:

Put an ox's bladder which has been previously soaked in water into the cavity of the uterus; fix a pair of bellows to the neck of the bladder, which projects from the neck of the womb, and blow the bladder up very forcibly; at the same time taking care that the uterus does not slip off the bladder: in this way it is possible to distend the uterus to a great size. Pipes are now to be put into the artery and vein of each side, and the cut vessels secured by tying them round the neck of the bladder. The best injection is that cold injection mentioned in page 2. During the dissection, it will be necessary to be very careful not to wound the bladder, as it would hardly be possible to blow it up again without injuring the injected vessels.

For making an injected preparation of these parts, see the rules laid down in Article X. page 37, respecting that part of the process, previous to any other dissection.

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* Curled hair is that commonly used for stuffing the seats of chairs, and may be had at the Upholsterers.

ARTICLE XIII.

Injecting and preparing the Heart in Situ with the Head, adjacent Blood Vessels, and Thoracic Duct.

A Heart for this purpose should be chosen as free as possible from fat; this is more frequently the case in young than in old subjects. Inexperienced students will often fix upon an old emaciated body, with a view to procure a heart without adeps; but they are generally mistaken: it is necessary that pupils, engaged in making anatomical preparations, should bear in mind the following circumstance, that the adeps of young, growing animals, is for the most part, placed exterior to the muscles, but in the aged, is removed to the internal parts, and deposited on the thoracic and abdominal viscera.

First make a longitudinal incision through the integuments from the trachea, to the extremity of the ensiform cartilage, and then with a saw divide the sternum in the same direction; detach the clavicle from it, and lay open the thorax, by bending back the divided portions, first dissecting them from the mediastinum, and cutting the inside of the cartilages partly through, about three inches from the sternum, taking care not to divide the mammary artery, coming from the subclavian, and running under the clavicle, down the inside of the cartilages of the ribs, near the sternum, on each side. The abdomen should also be opened, and the viscera dissected away, to give room for fixing the pipe into the aorta, immediately above the cœliac artery, distributed to the stomach, &c. this will fill the arteries in general; but in order to fill the coronaries of the heart, an assistant is to make a pressure with his finger and thumb upon the left ventricle, immediately below the semilunar valve, whilst the Injection is thrown into the aorta, or brachial artery: this pressure should be made in such a direction, as not to close the orifices of the coronaries going off just above the valves. The left side of the heart and pulmonary veins, may be filled by a pipe introduced into one of these veins, entering the left auricle; ligatures may be made on each brachial artery, just above the elbow; or a twisted tourniquette may be applied very tight, to prevent its running into the whole of the upper extremities: but the waste of the Injection would hardly be an object in this case. The arteries may be injected by one of the brachials, making a ligature on the aorta, just below the diaphragm. The veins and pulmonary artery may be injected,* by fixing a pipe in the vena cava ascendens, below the liver (so that the liver is not to be removed with the abdominal viscera); one in each brachial and cephalic vein; and what are not filled by these, are to be injected by such as are coming from different parts of the head and face. If the vena azygos, situated rather on the right side of the spine, in the thorax, should not be injected, it may be filled by a small pipe fixed in its inferior part; and last of all, the thoracic duct running between the aorta and vena azygos (which is not very easily discovered by persons unaccustomed to dissections, owing to its smallness and transparency) should be filled from the receptaculum chyli. The vessels being all injected, the dissection is the next part of the business: first remove the lower part of the body by a section, carried between the ribs to the last dorsal vertebra; then amputate the arms a little above the elbow; the other part of the dissection is the same as described under the head Injecting, Dissecting, &c. an entire subject, to trace and exhibit the arteries (See Article VII.) excepting the lungs, the principal ramifications of which only, are to be left.

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* Previous to injecting the veins, they should be cleansed, by repeatedly syringing them with warm water, from wherever the pipes are fixed, which is to make its exit through a small puncture made with a lancet, about a quarter of an inch in length, in the apex of the right auricle.

The dissection being completed, the parts are to be placed in a situation the most advantageous for exhibition. When perfectly dry, the preparation is to be done over two or three times with oil varnish; and as this, when well made, is of considerable value, it ought to be preserved in a glass case.*

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* When only the heart is to be injected, cut through the vessels going to the upper parts of the body, as they are emerging from the thorax, and remove the heart and lungs by tearing them, along with the trachea and œsophagus, from the spine, making first an incision along the spine, to free the intercostal arteries. Cut through the aorta and vena cava, below the diaphragm, a part of which must be left attached to the vessels, and removed with the thoracic viscera. It is necessary to remove the heart in this manner, that there may be no danger of bursting any of the great vessels.

Press out as much blood as possible from the vessels; put a pipe into one of the pulmonary veins, and another into the vena cava superior. Having injected warm water by these tubes, to

ARTICLE XIV.

Injecting a Fœtus, to shew the Course of Circulation when in Utero.

THIS is a preparation which requires no great ingenuity, though in making it, the most dexterous Anatomists frequently fail of success, owing chiefly to coagula obstructing the vessels. For this purpose, we can only make choice of such children as are dead born, or died soon after birth; the former are to be preferred: for in these the lungs having never been called into action, the pulmonary arteries are not so dilated and pervious; for which reason the Injection will probably

clear the heart of the masses of coagulated blood which are generally found in it after death, tie the lungs at their roots, the vena cava inferior, and all the divided arteries, except the aorta, into which a pipe must be put. Throw red injection into the pulmonary vein, which will fill the left auricle, left ventricle, aorta, and coronary vessels; but during this part of the injection, an assistant ought to hold and compress the aorta immediately after its giving off the coronary arteries, so as to press the injection on in them; but as by this the injection will be prevented from entering the aorta, it must be filled from the pipe which was inserted into it. The injection escaping by the intercostal arteries, may be stopped by the assistant throwing cold water on the injection as it flows from the vessels. The yellow injection thrown in by the vena cava superior will fill the right auricle, ventricle and pulmonary artery. The dissection required is simply the removing of the soft parts from the injected vessels.

pass with greater freedom through the Ductus Arteriosus* and Foramen Ovale.†

In order to proceed with the Injection, carefully dissect the vein from the arteries in the umbilical chord, which should be preserved three or four inches in length from the abdomen, and not suffered to get dry; when separated, fix a middle sized pipe in it, taking care not to include the arteries in the ligature; then inject warm water repeatedly, until it returns freely by the arteries in the chord; in doing this, no great force should be used at first, until the vessels become a little cleared of the coagula, or there will be a danger of rupturing them; afterwards inject air, to expel the water more perfectly; then throw in the coarse, coloured Injection with tolerable freedom, till it flows out of the arteries; on seeing which, stop the arteries by a ligature previously placed loose on them for this purpose; and when the vessels are sufficiently filled, remove the syringe. After the body is cold, proceed to the dissection, by first removing the head close to the basis of the skull, the arms with the scapulæ and pectoral muscles, the lower extremities at the articulation with the acetabulum, the whole of the integuments, muscles of the back, parietés of the abdomen, anterior part of the thorax, and all thoracic and abdominal viscera, excepting the heart. In removing the liver, care must be taken to avoid injuring the Ductus Venosus.* Preserve the injected vessels in the trunk, the body, and neck ; also the whole chain of vertebræ from the skull downward ; the posterior portions of the ribs, and the entire pelvis ; then carefully clean away all the cellular membrane, and what obscures the course of the vessels : place the preparation in a proper position for viewing to the best advantage, particularly the Ductus Arteriosus, and Ductus Venosus ; when thus placed, lay it in a situation most favourable for drying ; after which it should be varnished, and secured by a glass or case from accidental injuries, to which it is very liable.

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* Ductus Arteriosus is a canal passing from the pulmonary artery to the aorta, and becomes obliterated soon after birth.

† Foramen Ovale is an opening from the right auricle to the left, which becomes closed after the birth of the child.

ARTICLE XV.

Injecting and preparing the Penis.

FOR the purpose of an Injection, the adult penis is always preferred ; it should be removed from the body, for the convenience of conducting the process with the greater facility ; in separating it, the knife is to be carried close to the pelvis, to which it is connected by its two crura : the precaution of dissecting close to the pelvis, is to guard against wounding the crura, which, if neglected, might afford some trouble when injecting it, by the escape of the fluid. The dissection is to be continued toward the bladder, and the penis separated by a transverse incision just before the prostate gland; in doing this, the testes need not be removed, but a section of the scrotum should be made in the direction of the septum, to allow room for removing the penis; which being accomplished, the next part of the process will be to wash out the blood, which is always found, more or less, in the corpora cavernosa: this is performed by first fixing a middle sized injecting pipe into one of the crura, through a small incision made for that purpose, and then injecting warm water, which is to be pressed out again; and this should be repeated as often as the water returns bloody. Then find the orifice of the large vein, situated on the dorsum of the penis, in the groove, formed by the pecten, or septum penis, and advancing from the glans to the os pubis, called the vena magna ipsius penis. It will be necessary to distinguish this, from a vein in the integuments called vena tegumentorum; the former is deeper seated, and not moveable with the integuments, as is the case with the latter. A probe is to be introduced into the vena magna, as far as the glans, in order to break down its valves, which would otherwise obstruct the Injection: then fix a pipe in it, and cleanse it from grumous blood, by injecting warm water, and pressing it out again, as directed for cleaning the corpora cavernosa; being thus far prepared for the Injection, immerse it for about an hour in hot water, and fill the corpora cavernosa with coarse yellow Injection, and the vena magna, glans and corpus spungiosum with red; after which the integuments may be entirely dissected away; the preparation is then to be dried and varnished, or preserved in spirits of wine, without any thing further being done after the Injection.

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* The Ductus Venosus, is a canal of communication between the vena portæ and hepatic veins, near their termination in the inferior cava.

ARTICLE XVI.

Injecting the Testes.

THE testes designed for this purpose, should be removed from the body with considerable care; the spermatic chord, which is formed by three vessels, the artery, vein, and vas deferens, is to be divided as high as possible, and no where wounded. The artery may be filled with fine and coarse red Injection, and the vein with coarse yellow; the vas deferens, or excretory duct, should always be filled with quicksilver, as, on account of its smallness and prodigious length, it cannot be filled with any of the other Injections; even quicksilver requires considerable time to make its way through all its windings: it should remain suspended to the injecting tube, under water for some time,* that it may insinuate itself as far as possible. The Injection of the vas deferens should follow that of the other vessels. The extremities of all the vessels should be afterwards closed with ligatures; then the surrounding cellular membrane, &c. dissected away; and by laying the preparation in water for two or three days, the blood will be more effectually extracted, the colour of the Injection appear much brighter, and consequently be better seen; this being done, it may be suspended in the air, till the body of the testes is perfectly dry, and then preserved in oil of turpentine.

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* See Plate II.

Before the yellow Injection is thrown into the vein, that vessel must be repeatedly filled with warm water, in order to clear away all the grumous blood, which, by being retained, and drying on the colour, would have a disagreeable effect.*

ARTICLE XVII.

Injecting the Blood Vessels of the Mesentery.

In injecting the mesenteric vessels, separated from the body, care is to be taken to have all the extremities of the divided vessels previously secured; this done, find one of the largest arteries and veins near the root of the mesentery; into which fix proper sized pipes, and inject them with any two colours which afford a good contrast. The Injection will run into every part of the mesentery and intestines with great freedom, from their numerous anastomosis, and into the veins, equally free with the arteries, on account of there being no valves in this part.

For injecting the lacteals in the intestines, see the Article on that particular subject.

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* If we succeed once in ten times in making this a preparation of the testicle, shewing all the vessels, especially the tubuli, testis, we may think ourselves particularly fortunate.

ARTICLE XVIII.

Injecting of Bones, and rendering them transparent, to shew their Vascularity.

BONES are injected, either to show their natural vascularity in their healthy state, or the distension of the vessels in the state of inflammation; this must always be done with the minute Injection: there is no possibility of filling the vessels of a single bone, but by injecting at least the whole extremity, and the arteries only; for the veins cannot be minutely injected, because of the valves, except those of the head, which have sometimes been minutely filled by the jugulars.

An extremity for this purpose being removed from the body, a suitable sized pipe is to be properly fixed into the principal artery, and the part thoroughly heated in hot water; then proceed to inject according to the rules prescribed in Article II. To prevent any of the Injection escaping from the vessels divided in the removal of the part from the body, a ligature may be made just below the incision, with any kind of cord, and tightened by a twisting stick, in the manner of a tourniquette: care should be taken not to compress the artery through which the Injection is to pass; this is to be avoided by placing the pipe below the ligature. It must be remembered, that the object of this experiment, the bone, is frequently situated at a considerable distance from the surface; and that the part must be thoroughly heated before the operation is attempted, and therefore should lay several hours in the hot water, as by neglect of this, the whole intention will be defeated; the surface of an extremity will feel sufficiently heated whilst the centre remains, but very little, if at all affected: and again, if the Injection is not made thoroughly fluid, it will equally tend to frustrate the purpose of the operator.

After the part has been properly injected, and suffered to become cold, all the surrounding parts may be removed from the bone as clean as possible, and then laid in clean water for a few days, changing it daily, until the blood is fully extracted; it is then to be immersed in a weak acid liquor, made of one ounce of the muriatic acid, and one quart of water, in a glass vessel; in which liquor it is to lay two, three, or four months; the acid, thus diluted, will gradually unite with, and dissolve the earthy part of the bone, and not injure the animal fibres, or destroy the fine vascular organization; but as the acid becomes neutralized by the earth of the bone, it will be necessary to add a little more from time to time, to keep up its original strength. This process should never be hastened, by the addition of too much acid, for that will destroy the animal fibres, and ruin the preparation; an unpleasant circumstance, when every thing has previously gone on well. The bones should always be suffered to lay in the liquor a sufficient length of time to complete the process of removing the earthy part, or otherwise they never can be made so transparent, nor of course will they shew their beautiful vascularity to such advantage. When this process is effected, they will become soft and flexible. It should be then taken from the liquor, and suspended in the air till perfectly dry; then immersed in a glass vessel filled with fine oil of turpentine, when it will immediately assume a beautiful transparency, and shew innumerable minute vessels passing through its most solid parts, in as great abundance as any of the soft or fleshy parts of the body. The vessel being closed according to the directions given in the proper Article, it should be kept from the heat of the sun, which is very liable to burst vessels filled with oil of turpentine.

ARTICLE XIX.

A minute Injection of the Cutis, Intestines, and other Abdominal Viscera, to shew their Vascularity.

FOR this purpose, very young subjects are generally chosen; and the easiest and most common mode of injecting the cutis, or viscera, is by the ascending aorta, as for an entire subject (see page 38); with this difference only, that the minute Injection is to be used in this case: if the cutis is the object of the experiment, such part of it as is intended for preservation, after it is injected, must be laid in clean water, and changed every day, as long as it imparts a bloody tinge, and then is to remain in maceration, without changing the water, until the cuticle will easily peel off; by the removal of which, the vascularity is much more beautifully exhibited: after the removal of the cuticle, proceed with regard to its preservation, either by placing it in its recent state, in a vessel of spirits of wine, or by drying, and placing it in oil of turpentine, or preserving it by varnish.

With respect to the abdominal viscera, such parts as are to be preserved, must be treated in a manner similar to the cutis, by cleansing and preserving them in spirts of wine, or oil of turpentine, or by varnishing; but it is to be remembered, that such only may be preserved in turpentine, or by varnishing, as are thin, and capable of being previously dried, as the stomach, intestines, urinary bladder, &c. the more bulky parts, as the liver, spleen, kidneys, pancreas, &c. cannot be preserved in turpentine, unless thin sections of them are made, so as to render them capable of being dried without putrefaction.

Portions of the peritoneum, pleura, periosteum, and dura mater, may also be dried and preserved in oil of turpentine, or by varnishing.

ARTICLE XX.

Injecting and preparing the Head, to preserve its natural and healthy Appearance.

YOUNG children are the most proper subjects for this purpose; the head is to be separated from the body, as low as the fifth or sixth cervical vertebra; then thoroughly heated in hot water, and injected by the carotid arteries only, with the double pipe (see Plate I. Fig. 9) previously securing the vertebrals: for this preparation, red minute Injection is always to be used; and if thrown in with freedom, and as much force as will be prudent, considering the danger of rupturing the vessels, it will pass so perfectly into the cutaneous vessels, as to give the natural and healthy complexion. When the part is become cold, remove the pipes, and suffer it to lay in clean water, not only to extract the blood, but to promote putrefaction, so that the cuticle will easily peel off, which is to be removed from all such parts as are not covered with hair; this gives a brightness to the complexion, exhibits the vascularity of the cutis, and villi of the lips. If the cuticle be removed from such parts as are covered with hair, the hair will come off with it, and occasion an unnatural appearance. In the putrefaction, attention should be paid to the earliest period, when the cuticle will peel off, otherwise the colour of the cutis will be liable to change, and disfigure the preparation. The globes of the eyes will never retain their natural appearance in preparation, owing to the crystaline humour and transparent cornua becoming opaque; for which reason they should be removed, and the head supplied with artificial ones of glass, which are sold by the wax figure makers, or by the bead makers.

The preparation being thus far finished, it is to be preserved in spirits of wine, either entire, or in two parts; if the latter, a section is to be made perpendicularly through the middle, or rather a little on one side of the forehead, nose, mouth, chin, trachea, &c. and posteriorly, through the cranium, sagittal suture, occiput, and middle of the cervical vertebræ; the brain may then be easily removed, when the larger portion will afford a good view of the internal cavities, membranes, &c. The design in dividing the head a little on one side of the middle, is to preserve (in the largest portion) the falciform process of the dura mater, septum narium, &c.

This section should be made, first with a knife, through the soft parts; the bones will require a saw; and for the internal membranes, scissars will be more convenient.

OBSERVATIONS.

It is to be always remembered through this work, that where Injections with coloured fluids, to trace and exhibit the blood vessels by dissection, are treated of, or where the minutest vascularity is not the object of experiment, the fine and coarse Injections are both to be used; first, a portion of the fine, forced into the smaller branches by the coarse, which is immediately to follow it. For corroded preparations, the coarse only is to be used, as the fine is much too fluid; and it is necessary they should be made with an Injection which has a firm body, sufficient to support their weight even in warm weather. Cases wherein the extreme vascularity of parts is to be exhibited, the minute or size Injection only is to be used. It will be more particularly necessary to bear these Observations in remembrance, as they are not repeated in every article.

MERCURIAL INJECTIONS.

ARTICLE XXI.

General Observations on injecting with Quicksilver.

QUICKSILVER is often used for Anatomical Injections, on account of its minuteness, its permanent fluidity, and not being subject, like other fluids, to spontaneous evaporation; but if there could be a method of rendering it a solid, flexible body, after it is thrown into the vessels, and had we the art of communicating to it different colours, it would become much more extensively useful. The continuance of fluidity, whilst in the vessels, is one of the greatest objections to its use; as on this account it is impossible to dissect with any freedom among vessels filled with it; for by making the least wound in these, the whole will be liable to escape, especially where there is a communication by collateral branches, unless immediately secured. Its specific gravity is also another considerable objection to its use; for although it is so useful a circumstance in the act of injecting, yet by the weight of the preparation, it is very apt to strike so forcibly against the sides of the glass in which it is kept, as to rupture the vessels: for these reasons it is but seldom used, where the other usual Injections can be employed.

When injecting with quicksilver, it will be necessary to bear in remembrance, that the force of the Injection depends upon the perpendicular height of the column, and not its diameter; and thence should be careful not to raise it to a greater height than the vessels are able to bear.

In making quicksilver Injections, the principal ingredients, and the first to be obtained, are time and patience, and not less so, an uniform fortitude against disappointments; for it will not unfrequently happen, that with the greatest care, a most promising preparation will be instantaneously destroyed by some trivial accident, when it has been almost completed.

Preparations of this kind should never be made upon a bare table, but on a broad dish, or the injecing Tray made particularly for that purpose; otherwise we may waste much more quicksilver than is used, and the price of the article renders it an object of some consequence with those, who are in the frequent practice of using it in this way. The Tray which I have invented for this purpose, is represented in Plate III. The shape therein described, is not adapted to the injecting of legs, arms, or the trunk of the body; for those larger preparations, others upon the same principle may be constructed of suitable dimensions.

EXPLANATION OF PLATE II.

Representing the Injecting Tube, and its Appendages, for the Purpose of filling the Lymphatics, Lacteals, &c. with Quicksilver.

Fig. 1. A. The glass tube fixed in its steel cock: the tube here represented is seven inches in length; but for different purposes, they are made from five to twenty inches; some vessels requiring a much higher column of quicksilver than others.

B. The cock, for the advantage of retaining or discharging the quicksilver at pleasure, by turning the handle of the plug C in a transverse or longitudinal direction.

D. A screw at the bottom of the cock, adapted to the socket of the pipes; the screw is to fix the pipes with greater security to the cock, than the common method, which is only upon the principle of a plug.

D. A leather collar at the top of the screw, which is pressed by the socket of the pipe, to prevent more effectually an escape of the quicksilver between the threads of the screw.

F. The plug of the cock taken out; this, by its tapering, always fits close, and works smoothly in the cock. In the middle of the plug is a perforation, in the direction of its handle, through which the quicksilver passes, when it is turned in the direction of the tube.

G. A leather collar, which is placed round the small end of the plug, after it is introduced into the cock.

H. A steel collar, which receives the square end of the plug, after the leather one.

I. The plug screw, which is screwed into the small end of the plug: this confines the plug in the cock, by preventing the collars from slipping off; and the head of the screw pressing on the steel collar, that presses the leather one between it and the side of the cock, the leather, by its softness and elasticity, causes the plug to move smoothly.

Fig. 2. The curved pipe, which screws on to the end of the cock D, in order for use, which screw is adapted to the socket of the pipe K.

L. L. The cross pins, for the purpose of passing the ligature round, to prevent the pipe from slipping out of the vessel, when introduced.

The advantage of its curvature is, to fill, with the greater facility, vessels lying horizontally, as on the surface of a table, whilst the tube is kept in a perpendicular direction.

Fig. 3. A pipe which only differs from the above in its being straight; this is intended for filling vessels in a perpendicular direction, particularly when the tube is to be suspended in the injecting Tray, with the preparation under water, for a considerable length of time (see Plate III).

Fig. 4. A slender piece of steel, called the clearer, or poker; it has its upper part flat, to answer the purpose of a handle; its use is to clear the pipes of any thing which may obstruct the passage of the quicksilver; this is done by passing the point through the socket of the pipe to its extremity, or as far as it will go, and moving it backward and forward several times.—From

Plate II

Fig. 1

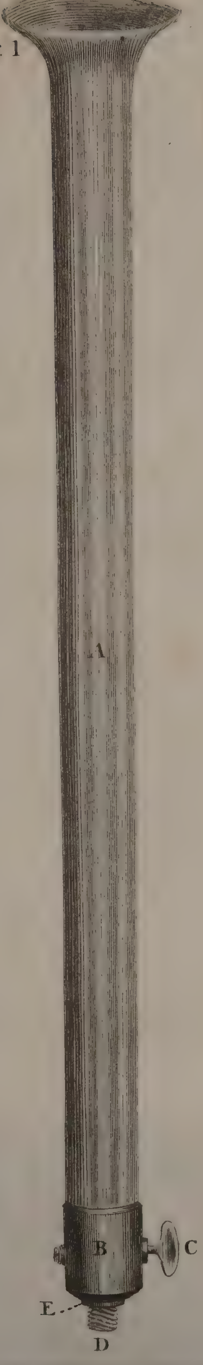


Fig. 5

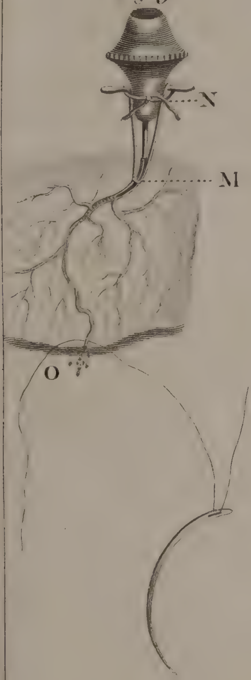


Fig. 2

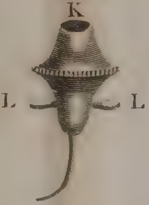


Fig. 3

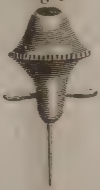
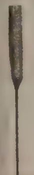
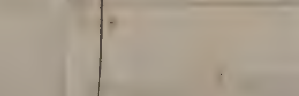


Fig. 4





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W. Darton & Co. sc.

its elasticity, it will answer equally well for the curved, as for the straight pipe.

Fig. 5. Represents a curved pipe fixed in a blood vessel, and secured by a ligature, for the purpose of filling it with quicksilver.

M. The first knot made with the ligature, passed round the vessel, below the orifice, by means of a needle, for the purpose of compressing it equally on all sides of the pipe, to prevent the escape of the quicksilver.

N. The second knot made with the ligature, after it has been turned over the cross-pins, to prevent the pipe slipping out of the vessel.

O. The orifice of a vessel, divided in removing the part from the body, with the quicksilver escaping in globules; under which is a small ligature passed, by means of a needle, in order to close the out-let by a knot; this shews the manner of securing the quicksilver in the vessels during the process of injecting, or before the Injection commences.

Every part of the cock, pipes, and clearer, must be made of steel, as any other metal would be amalgamated by the solvent property of the quicksilver. Care should be taken always to wipe over the metallic parts with an oily cloth, after each time of using this instrument, or they will otherwise soon be destroyed by rust.

ARTICLE XXII.

Injecting the Lymphatics with Quicksilver.

THE Lymphatics are a system of vessels of modern discovery, intended to absorb from all parts of the body, the superabundant fluids deposited by the exhalants, or otherwise; the action of these constitutes that power of the constitution, by which morbid affections are often suddenly removed, without any direct external evacuation. They are small delicate transparent vessels, appear knotted, or irregular, from the abundance of their valves, and are found arising from every part of the body. In order to discover these vessels, make an incision in the cutis, and remove a part of it as far as the cellular membrane, where they arise plentifully, yet, from their transparency, may so elude the eye, as to require a magnifying glass to discover them.

The subjects most favourable for injecting, are those who have died anasarcous, as in such the lymphatics are somewhat enlarged, and more evident. This is one of the most delicate preparations, requiring the greatest dexterity of any part of experimental anatomy. It will be, in general, requisite to consider the course of circulation through these vessels, which are above all others, most plentifully supplied with valves, and from which cause the quicksilver will, in most instances, only pass in the natural course of circulation. It is to be remembered, that these vessels are arising from all the remote parts of the body, and directing their course towards the Thoracic Duct, where they terminate in its lower extremity, called Receptaculum Chyli, situated anteriorly on the spine, below the diaphragm; and this empties itself into the left subclavian vein; so that to inject the lymphatics of an extremity, or any other part, it is necessary to search for those most remote from the Thoracic Duct; and then with the point of a lancet, make an orifice in one of them, sufficient to introduce the pipe, which is to be kept in that situation by the finger, or rather by means of a ligature; and when the cock is turned, the quicksilver will be seen to flow up the lymphatic, though after the first entrance of the quicksilver, the uniformity of the stream will prevent our being able to judge whether it continues to flow or not, unless by looking into the glass tube, where we may readily perceive, that it is either gradually sinking, or perfectly stationary; and this is the only criterion of its real success: if the mercury sinks too fast, it indicates a rupture in the vessels; as long as the column continues to lessen gradually, we are to hold the pipe in its situation, and when it ceases to flow any longer, secure the mercury by a ligature, and withdraw the pipe.

Should there be any out-let to the mercury, through a collateral lymphatic, it is to be immediately secured by a needle and ligature, as shewn in plate II. fig. 5. When the mercury has ceased to flow, the pipe removed, and the vessel secured, then proceed to trace the course of the vessel, by a most cautious dissection, with a pair of dissecting forceps and finely pointed sharp scissars, taking great care not to wound, in the smallest degree, the vessel containing the mercury; but should such an accident happen, immediately secure the orifice, by pressing it between the finger and thumb, until it can be more securely stopped by a fine ligature, made above and below the orifice, and as near to it as possible, that the rupture may appear trivial. Sometimes when they have lost a considerable portion of the mercury, they may be distended, by a second introduction of the pipe into the same, or a communicating collateral branch; but in this system of vessels, there is not so frequent anastomosis as in the arteries and veins. As the dissection for the lymphatics is necessarily very slow and tedious, from the great care required in performing it, it will be proper to prevent the parts getting dry, by exposure to the air after they have been opened: the best method of preventing this, is to open as little as possible at once, and when left, to cover it over with a wet cloth, three or four times folded. When the injected vessels are cleared of the surrounding adeps, cellular membrane, &c. and exhibited to the best advantage, let them be dried in a situation where the air has free access, and the rays of the sun excluded; when dry the preparation should be varnished, and secured from accidents, by being kept in a glazed case.*

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* In injecting Lymphatics, our success depends, perhaps, more on the body we chuse, than on any other circumstance. It has been commonly said, that dropsical bodies were the best for making lymphatic preparations from; but it will be found, that bodies but slightly anasarcous, if they be emaciated, are

the best. In a patient dying of consumption, or any disease by which the fat of the body has been absorbed, we shall succeed perhaps better than in any other. It is not merely the finding the lymphatics easily, and filling them with mercury, (for this may be done in almost any body) that the success of the preparation depends, but more on the quickness of drying the parts after the vessels are injected.

From the valvular structure of the lymphatics, it is necessary to inject from the extremities towards the trunk. In injecting an arm, or leg, we ought to begin as near the fingers, or toes, as possible; though we never can expect to inject the lymphatics as far down as they are represented in some anatomical plates.

There is a very great difficulty in discovering lymphatics, which is owing to several causes. They are very small, but it is their being generally empty, and their coats being transparent, that form the great difficulty. It is advised, by some, to make use of magnifying glasses; but these will be found of little or no service, as it is not so much their small size, as their transparency, that is the cause of their obscurity. Small branches of nerves, and small veins, are very often mistaken for them; and even the most experienced eye will not always discover his mistake, until he attempts to fill them with mercury.

It is almost in vain for any one to attempt injecting lymphatics without an assistant; there are so many things requisite, besides merely the holding the tube in the vessel, that he will find he can make little progress by himself.

It is necessary before beginning, to see that there is within his reach, sharp-pointed scissars, knives, forceps, lancets, pokers for tubes, needles, and waxed thread, so arranged that they can be used instantly; for it will often happen, that it will be almost impossible for either the assistant or the operator to take his eye for a moment off the vessel, without losing it. It is very requisite, also, that the assistant be very dexterous, as his office is often one of greater difficulty than that of the principal operator.

Having every thing arranged, place the foot or hand in a tray, to catch the mercury that may fall. The foot ought to be a little more elevated than the groin, to assist the flow of the mercury towards that part. With a sharp scapel, cut off a portion of the skin horizontally, so as to expose the loose cellular texture; for in this texture are the superficial lymphatics generally situated. If there is not one to be found near the toes, which is very often the case, it will probably be possible to find one running across the saphena magna, on the instep. Having found one, take hold of it with the forceps, dissect it from the surrounding substance, and, to secure the keeping of it, put a needle with a fine waxed silk thread under it. Having still hold of it with the forceps, snip it half across with fine scissars, and into the cut made by the scissars, introduce the fine poker, (which is made for clearing the pipes). Take now, from the assistant's hand, the tube containing the mercury, with the stop-cock already turned, and let the stream of mercury play on the side of the poker, which generally so directs the stream that it enters the vessel; and when once you have succeeded in getting a few drops of mercury into the lymphatic, it will be easy to get the pipe into the open mouth of the vessel, and then the poker may be withdrawn.

There is an apparent clumsiness in this method of filling the vessels; but in this manner the smallest vessels may be injected, when it will be found quite impossible to inject them in the old way of puncturing the lymphatic with a lancet, and introducing the point of the tube into it. The scissars make a better kind of cut than the lancet, though there is a great deal of nicety required in using them, as we are very apt to cut the vessel completely through. The poker is of very great service, as by it, it is always possible to know whether it is a lymphatic or a small nerve that we have got; if it be a lymphatic, the poker passes on smoothly; if a nerve, it does not pass on smoothly, but tears the nerve into fibres. When introduced into a lymphatic, it holds aside the lips of the cut, so that the mercury passes into the vessel by the side of it.

If the vessel be a large one, into which the pipe is introduced, it ought to be tied round the pipe with the thread which was previously put under it. The mercury is to be pressed on by the assistant, with the handle of the knife, while the injector ought never to take his eye off his pipe, and according to the direction of his assistant, elevate or depress the tube containing the mercury, which will regulate the force of the injection. The mouth of the vessel ought to be moistened at intervals, to prevent its getting dry, which impedes the flow of the mercury. This lymphatic may have chanced to fill a considerable number of vessels on the thigh — the mercury is still to be pressed on to the glands in the groin, taking care that the foot is not too much elevated, as by that, the column of mercury would be elevated higher than the vessels in the glands could bear, especially as the lymphatics at this part seem to be more easily burst than at any other. We ought now to discover as many lymphatics as we can, in the neighbourhood of the first, and proceed with them in the same manner. If the glands are not completely filled, we ought to endeavour to find for each gland, the vessel that has the most influence in filling it, (for there generally appears to be one vessel which fills the gland more quickly than the others). Having found it, we secure the other vessels, and fill up the gland from its principal vessel. If we want to make a good display of the glands at the groin, we ought to tie the secondary vessels arising from them, as the mercury often passes into the secondary vessels, before it fills the gland itself.

These vessels ought to be dissected and dried as quickly as possible; for if the limb becomes putrid, the mercury in the lymphatics is very apt to become black. After exposing them, they ought to be tied at regular intervals, and always kept in the horizontal position, as they are very apt to burst when dry.

In injecting the lymphatics of the liver, or the lacteals of the intestines, by merely puncturing the vessel with the lancet, we may generally succeed; for then there is a surface opposed to the vessel, which keeps it more steady than the vessels in the limbs.

By blowing air into the lymphatics, we may inject them more easily; but, there is always the disadvantage attending this method, that the air prevents the flow of the mercury into the glands.

These preparations are attended with so much trouble in their making, that it is of some consequence to be able to preserve them. If we endeavour to do this is by merely varnishing and drying them, we shall soon see our labour defeated; for the change from the horizontal position, or a change of temperature, will, in all probability, burst the vessels. By preserving them in spirits of turpentine, we not only avoid the changes of temperature, and the destruction by insects, but add much to their beauty.

☞ The Publisher is indebted for the foregoing remarks, to a Gentleman who has assisted Mr. Bell, in the School of Windmill Street, where, of late, a very splendid addition to the lymphatic preparations has been made.

ARTICLE XXIII.

Injecting the Parotid Gland with Quicksilver.

THE Parotid Gland is situated posterior to the masseter muscle, and anterior to the lower part of the ear; it extends from the zygomatic arch to the angle of the lower jaw; its duct passes over the masseter, and through the buccinator into the mouth.

This gland should be injected in situ, on account of the numerous branches which it is giving off on all sides, and which are so transparent, as to escape the eye of a common dissector, unless they are rendered more visible, by being first filled with quicksilver. In conducting this operation, raise the cutis on the side of the face, from the ear to the mouth, and from the temporal muscle to the neck, taking care to keep the knife close to the skin, that it may not wound the gland; then with the utmost caution, dissect away the adeps and cellular membrane, from the masseter muscle, in search of the duct, a tube of about two inches in length, and the size of a crow quill, easily eluding the search of an inexperienced student: when discovered, make an opening into it with the point of a lancet, sufficiently large to introduce the point of the steel injecting pipe, as distant from the gland as possible; and when introduced, confine the duct upon it by a ligature, with a single knot, that it may serve, when the pipe is withdrawn, to secure the quicksilver in the gland; and that if any accident should render it necessary to relax or remove it, it may be done with the less difficulty, or without danger of injuring the duct. When the gland has received as much of the quicksilver as it can contain, the pipe withdrawn, and duct secured, proceed with all possible care to dissect it from its situation, remembering a slight wound in the gland would be likely to destroy it; in this process, the numerous branches going off to the surrounding parts, should be secured by a very small curved needle and single ligature, after which they may be divided with safety; when the gland is thus removed from its situation, lay it in a dish, and take away as much of the surrounding useless parts as possible, without endangering it; then lay it in clean water for a day or two, to extract the bloody colour; after which it is to be spread upon a piece of pasteboard, and placed in the air until perfectly dry; then remove it from the pasteboard, and preserve it in a glass vessel of fine oil of turpentine.

ARTICLE XXIV.

Injecting the Lymphatics on the Surface of the Liver, with Quicksilver.

PROCURE the liver of an anasarcous subject, take a portion of it about the size of a hand, upon which the lymphatics are most visible; they are small, and almost imperceptible whitish lines, running plentifully on the surface; the part to be injected should be laid in a dish, or the injecting Tray, to catch the quicksilver, which would otherwise be lost; then with the point of a lancet, puncture one of the largest of them, sufficient to introduce the pipe of the injecting tube with ease; the curved pipe should be used for this purpose, that its point may stand horizontally, corresponding with the direction of the vessel, whilst the upper part of the tube is inclined obliquely toward the shoulder of the operator, as a pen is held in the act of writing; the column of quicksilver in the tube may be raised to about five or six inches; when it begins to flow, it will be necessary to prevent its escape from the vessel, by pressing the finger gently upon the orifice, or by a ligature upon the pipe, taking care not to obstruct the flow of the quicksilver; if, when a small portion has passed into the lymphatics, it seems inclined to stop, it will then be necessary to force it forward, by a gentle pressure with the edge of a steel spatula, urging it in that direction in which it seems most inclined to run; by this the valves will be broken down; being in this viscus particularly weak, so that we may inject without regard to the course of circulation; when the quicksilver is pretty uniformly distributed over the surface, remove the pipe, and secure the orifice as usual; then cut the injected portion of liver, from that part which is not intended to be preserved, taking care to keep the knife at a sufficient distance from the injected lymphatics, as wounding them would occasion the escape of the quicksilver, and greatly injure, if not ruin, the preparation; remove also from the under side of it, as much of the liver, as will leave it not more than half an inch in thickness; then pin it out smooth upon a piece of pasteboard, with the injected surface outward, and suspend it in a current of air, until it is perfectly dry; then take it from the pasteboard, make its edges even, and preserve it in a glass vessel of fine oil of turpentine. When the preparation is dried without putrefaction, there is a lively and beautiful contrast of colour between the quicksilver and the dark brown of the liver; but this preparation will be still improved by the peritonæal vessels being injected with a bright red (see Article XIX.)

ARTICLE XXV.

Injecting the Lymphatics on the Surface of the Lungs, with Quicksilver.

THE Lungs of an anasarcous subject are to be preferred for this purpose, as the lymphatics on these are much larger, though not so easily discovered, as those of the liver; nor can they, as in the liver, be injected contrary to the circulation of the lymph, on account of the valves being much firmer, and not so easily broken down: for this reason, the mercury should be injected from the inferior part of the lungs, when it will pass with facility toward their root. The lymphatics of this viscus, take a direction different from those of the liver, and run in a circuitous direction. What further regards the introduction of the pipe, the manner of injecting, drying, preserving, &c. portions of the lungs, need not differ from what has been said in the preceding article respecting the liver.

ARTICLE XXVI.

Injecting the Veins in the Kidney of a Cat, with Quicksilver.

THE veins in the kidney of a cat run very superficial, and branch out in a manner peculiarly beautiful, which is the only inducement to make this preparation. The manner of injecting it is very simple; nothing more is necessary than to fix the straight pipe of the quicksilver injecting tube into the vein by a ligature, and inject with a short column; it should be suspended in water, that it may have time to insinuate itself into all the small ramifications; then remove the pipe, and secure the quicksilver in the vein, as usual; dissect away the surrounding cellular membrane and adeps, and preserve it in spirits of wine.

These vessels may be injected with coloured minute Injection, to give the same appearance; but a very small syringe and pipe should be used for the purpose.

ARTICLE XXVII.

Injecting the Arteries and Veins of the Hand, with Quicksilver.

For this purpose, a hand should be chosen the most emaciated, such as are generally found upon aged persons, who have died of some lingering disease, and upon women rather than men. The fore arm should be separated by a transverse section, about three inches above the wrist, and the steel pipe fixed in the radial artery, with a ligature; then pour the quicksilver into the tube, and conduct the process as before described; as soon as they get filled, it will begin to flow out of the other vessels, where the section is made; then let the arteries be first secured, by taking hold of them with the dissecting forceps, whilst an assistant ties them with a ligature, and afterwards the veins in the same manner; if they cannot be perfectly stopped by this means, apply a strong cord round the arm, a little below the incision, and tighten it in the manner of a common twisted tourniquet; but care should be taken not to make the compression with the cord so great as to obstruct the quicksilver from passing in; this may be easily regulated; for a descending column in the tube will overcome a much stonger resistance than the ascending column in the vessels of the hand, on account of the greater perpendicular height of the former. When all the vessels are secured, the hand should be properly suspended in water (see Plate III.) with the tube and column of quicksilver, so as to continue the Injection for a day or two, to give it full time to pass into the minute vessels; then remove the pipe, secure the artery by a ligature, and twist the cord tighter: the preparation is to remain in water, till putrefaction takes place, so that the cuticle may be easily peeled off, otherwise the hand would not dry; and if it should with the cuticle on, it would tend in a great degree, to obscure the injected vessels. The preparation is then to be hung in the air, and, when dry, should be carefully varnished, and fixed on a pedestal of Plaster of Paris, secured from the dust by a glass cover.

These preparations, when well managed, are very beautiful; for the quicksilver passing from the arteries into the veins, afford a most elegant display of the vessels, and there is no other way by which the veins of the hand can be readily injected with minuteness.

The reason why I have not mentioned securing the divided vessels before the Injection was attempted, is, that the quicksilver, by passing out, may have opportunity of removing from the vessels any coagula which might tend to stain the quicksilver, and mar the beauty of the preparation.

ARTICLE XXVIII.

Injecting the Female Breast with Quicksilver.

It requires no small share of time and patience, to make a complete preparation of this kind. The manner of conducting the operation is, first, to remove the breast from the subject, by an incision carried round its basis, so distant as to avoid wounding the lactiferous tubes, which will be more evident, and much better adapted to this purpose, if they have been recently distended with milk. Next examine the nipple for the excretory ducts, and introduce a bristle into each, about ten or fifteen in number; afterwards withdraw one of them, and cautiously introducing the strait pipe, distend the tubes with quicksilver: when completely filled, secure its orifice by replacing the bristle, then withdraw the next, introduce the pipe, and distend the tubes as before, and so on until they are all injected, and the orifices of their ducts secured by a ligature, embracing the whole nipple, when the bristles may be withdrawn; for it must be remembered, that the lactiferous tubes do not anastomose, that is, the tubes terminating in one excretory duct, have no communication with those belonging to another; which circumstance renders it always necessary to inject by each duct separately.

As sometimes, notwithstanding all the care that can be taken in removing the breast, some small tubes branching into the surrounding adeps, at a considerable distance, will be divided, through which the quicksilver will escape on the posterior surface; these must be secured by a ligature, whenever they occur in the course of the operation; this being effected, carefully dissect away all the adeps, cellular membrane, &c. from the posterior side; the integuments are also to be removed, and the adeps situated between them and the lactiferous vessels: this will require great care not to wound them. The part should then be macerated, to free it as much as possible from blood, taking care to avoid putrefaction, which would weaken the vessels, and occasion the escape of the quicksilver: after which, let it be exposed to a current of air, to dry as soon as possible; when effected, preserve it in fine oil of turpentine, which will give it a transparency, and render the distribution of the lactiferous tubes very visible.

ARTICLE XXIX.

Injecting the Lacteals with Quicksilver.

THE Lacteals are an extremely delicate and transparent set of vessels, which arise from every part of the intestines, and pass through the mesentery towards its root, in order to convey the chyle from the intestines to the thoracic duct; in the human subject, they are very similar to the lymphatics, and like them, numerously supplied with valves, which prevent them from being injected contrary to the course of the chyle. They are more visible in subjects that have died suddenly, soon after eating a full meal, being then distended with the chyle, produced by the aliment recently taken in. They are to be injected in the following manner:—take a small portion of the intestine and mesentery, and make an incision in one of the most conspicuous Lacteals, as near as possible to its origin in the intestine; then introduce the point of the injecting pipe, and conduct the operation agreeable to the rules before described in the preceding articles; when the quicksilver flows out of any of the divided vessels, they are to be stopped by an assistant (see plate II. fig. 5); when as many of the lacteals are filled as will receive the quicksilver from this orifice, introduce the pipe into another, and repeat the process as before, and so on until as many of them are filled as can be; then inflate the intestine, and suspend it in the air to dry, or if there should be any orifice through which the air may escape, let it be distended with wool; the part being perfectly dried, the wool should be removed, or the air evacuated, by cutting off the two ends of the intestines, as also to give access to the oil of turpentine, in which it is to be kept; or it may be preserved by varnishing, both inside and out.

The intestines of the turtle are very favourable for preparations of this kind, as in them the lacteals are much larger in proportion to the animal, than in the human subject, and sometimes may be injected contrary to the course of the lymph. The lacteals in fishes have no valves.

The beauty of these preparations will be much increased, by the arteries being also injected with the fine and coarse red Injection, and the veins with yellow.

EXPLANATION OF PLATE III.

Representing the Injecting Tray and its Appendages, for the purpose of facilitating the Process of Quicksilver Injections, and preventing the Loss of Quicksilver, which is constantly sustained in the old method.

A. The Tray; this should be made of boards, about three quarters of an inch in thickness, and of such wood as will be the least likely to warp; which will be more effectually prevented by the several parts being joined together with screws; and by painting it three or four times over, it will prevent the wood absorbing the water, and more effectually secure it from warping: every joint should be made perfectly water-tight, and the inside painted black; as this is much more favorable for seeing the fine parts of white membranes laying upon it, and the quicksilver flowing through the minute ramifications of their vessels. The machine being made in this form, is intended to be occasionally filled with water, for the purpose of injecting broad and flat parts, which require to be so managed as to prevent their drying, and to which the common jar, represented in the plate, is not adapted, as placentæ, large portions of mesentery and intestine, female breasts, &c.

B. An iron pipe. for the purpose of drawing off the water and quicksilver, remaining in the tray after the injection is finished; it is made of iron, that it may not be affected by the quicksilver. It needs no other stopper than a common cork.

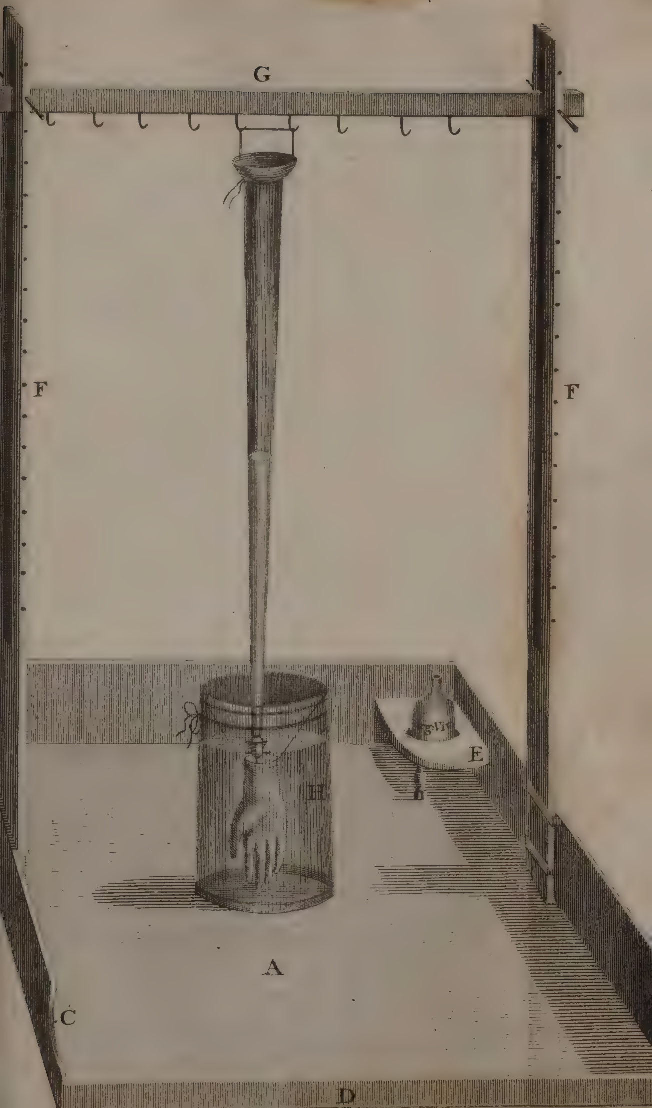
C. C. The right and left sides of the tray, cut down to form a rest for the arms, whilst the hands are employed upon a preparation at the bottom of it. The front D, is also made considerably lower than the sides, for the more convenient management of the preparation. The bottom of this tray, should be about twenty inches square; the front about three inches high, and the sides four and a half: the clear dimensions on the inside are here meant.

E. A ledge in one corner, for the convenience of fixing the bottle containing the quicksilver: it has a hole sufficiently large to receive the bottle, which is let through, and stands on the bottom of the tray, to preserve it from any accident, which it is very liable to from its weight.

F. F. Two uprights; the foot of each fixes in two square staples, within the right and left sides of the tray, and ought to be about twenty-four inches high.

G. The cross-bar; the ends of which slide up or down in the mortise of the uprights, and are fixed to any height, by means of pins passing through them, and the ends of the cross-bar, to keep them steadily fixed to each other. In the lower edge of this is fixed several small hooks, from which may be suspended one or more injecting tubes, as represented in the plate.

H. Is a glass jar containing water, in which is immersed a hand; with the quicksilver injecting pipe fixed in the artery, as in the process of filling the vessels. The hand is suspended by a string from the edge of the jar.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CORRODED PREPARATIONS.

ARTICLE XXX.

General Observations on corroding, varnishing, and preserving Injected Preparations.

PREPARATIONS injected for the purpose of corrosion, should always be carefully handled, lest the Injection be incautiously broke, which in their finished state, having no support from the surrounding vessels, will fall to pieces; this would be an unpleasing circumstance, after every thing else has been successfully conducted. The part, when injected, should be immersed in an acid liquor,* composed of three parts of muriatic acid, and one of water, in a glass vessel of suitable construction (see Plate IV.) for about three, four, or six weeks, as may be required, until its texture be entirely destroyed, and reduced to a soft pulpy state; it is then to be removed from the acid, by taking hold of the strongest part of the Injection in the largest vessels, and lay it in a bason filled with clean water; in that situation direct a gentle stream of water upon it, sufficient to wash away the pulpy substance; when it is nearly cleansed in that way, take it out, and hold it by the large trunk under the stream, by which it will have a better opportunity of passing through the interstices than before; but this should not be done until it be tolerably cleared from the pulpy part, as the weight of it would be in danger of breaking off the vessels by which it was held, especially with the additional weight and pressure of the water falling on it.

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* Nitric Acid is recommended by Sue, the French anatomist.

The stream for washing Corroded Preparations, should always pass through a cock, as by that means it can be exactly regulated to what size or force we please; a stream formed in almost any other way, is liable to variations, and a sudden unexpected increase of water would also greatly endanger the preparation. The injecting syringe with a small pipe may be used for this purpose, where a stream cannot be obtained through a cock, and in some respects will answer better, as by that a small stream may be directed to any part particularly requiring it. If the pulp does not readily wash away, it should be laid in the acid liquor again for a week or ten days more, and the washing repeated. When it is perfectly clean, it should be suffered to lay in water for a few hours, to take off all the acid which may adhere to it, and afterwards suspended in the air to dry; for this purpose, always avoid using thread, or any thing of that kind likely to cut through the vessels, especially if the preparation is of considerable weight, or the Injection soft; for many valuable preparations have been lost by their falling, when suspended by such means: for this purpose then tape is preferable, or a slip of soft cloth passed through a division of the largest trunk of the veins or arteries, most likely to sustain its weight. When there are no strong vessels favourable for this purpose, it may be carefully laid on a bed of wool, covered with a piece of fine soft linen, to prevent the wood entangling with the extremities of the vessels; on this it is to remain till perfectly dry, then varnished according to the directions to be given in their proper place.

These preparations require great care and much time to complete them, and when finished, are of all others most liable to be demolished by trivial accidents; it is therefore expedient to defend them as much as possible from injuries; for this purpose they are to be fixed upon pedestals of Plaster of Paris; a hole is to be made in the top of the pedestal, large enough to receive the trunks which ramify through the gland, or other part prepared; then this hole should have a proper quantity of fluid plaster poured into it, the preparation immediately placed in the pedestal, and held in a proper position, until the plaster has become hard enough to support it. These pedestals are then commonly fixed with glue on a mahogany stand, and covered with a glass vessel; but this method is not a sufficient security, unless the glass cover is cemented down, as its occasional removal will endanger the preparation: for persons who have not made them are not always satisfied with looking, but every now and then trying their strength by the finger, at the expence of destroying its most beautiful parts; neither does the moveable cover sufficiently exclude the dust. The most effectual method of preserving them from accidents, dust, and officious hands, is, to fix them in box frames, which may be oval or square; the ovals are the neatest but the most expensive, they may be glazed in front, or front and back. The glass should be let in upon an outside rabbet,* and confined by slips of paper being pasted along the outside of the same rabbet, extending over the edge of the glass: These frames should be lined with white paper, or any coloured paper, if necessary, to be contrasted to the colour of the Injection; the outside is generally blacked.

These preparations, when thus finished, should be kept from the rays of the sun, and heat of the fire; which, if the Injection is not very hard, will be likely to soften it, so that the branches will become flexible, and bend by their own weight.

EXPLANATION OF PLATE IV.

A Representation of two Kinds of Vessels, for corroding Injected Preparations.

Fig. 1. The covered Goblet intended for hearts, livers, lungs, kidneys, spleens, and such parts, which somewhat approach to the spherical form: it may be made of any size, adapted to the preparations above mentioned; the glass cover is intended to prevent the evaporation of the acid, which would otherwise take place. In the centre on the inside of the cover, should be made a glass loop, to receive a hook, for the purpose of suspending such preparations as will admit of it.

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* A term used among mechanics, to imply a channel in the edge of a board, &c.

Plate IV

Fig. 1

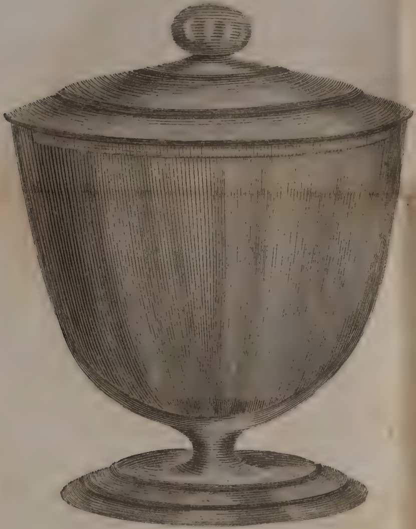

Fig. 2

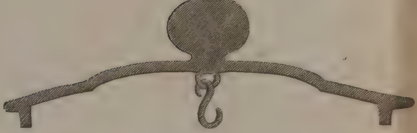

Fig. 3

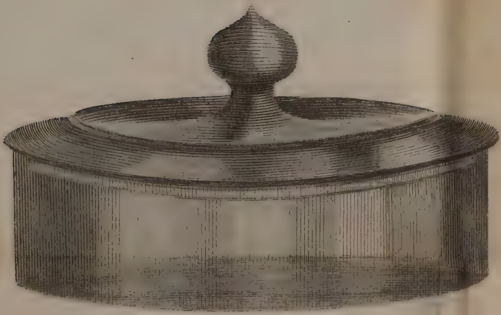

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Fig. 2. A section of the Cover, shewing the loop and glass hook: there should be in reserve several hooks of different lengths, for if too long, the preparation will rest upon the sides, or bottom of the vessel; and if too short, it would not be completely immersed in the acid liquor, so that the hooks of different lengths will be required for different preparations. It is only in some cases the hook can be used at all, and they are such, whose vessels bifurcate, before they are lost in the part to be corroded, so as to admit the hook to be placed in the angle, as in the trachea, and sometimes the kidneys. It is necessary it should be made of glass to withstand the action of the acid. This invention is to prevent the fine extremities of the vessels from being broken or bent.

Fig. 3. The glass corroding Bason. This vessel is broad and shallow, with a flat bottom, particularly intended for corroding placentæ, as well as some other preparations similar in their figure, or for the containing a number of smaller parts, without their lying one upon another, by which they would receive considerable injury.

These vessels, as they are not intended for ornament, or exhibiting the preparations, may be made of common green glass, which will render them of a much lower price than if made of white flint.

ARTICLE XXXI.

Injecting and Corroding the Heart and Vessels of the Lungs.

For this purpose, those of young subjects should be chosen, on account of the inconvenient size of adult parts.

The first part of the process is to remove as much as possible the coagula from the cavities of the Heart and adjacent blood vessels, that it may not obstruct the passage of the Injection. The right side of the Heart and pulmonary artery, may be injected by either of the venæ cavæ, fixing a pipe in one of them, and securing the other by a ligature: its left side and pulmonary veins may be injected by the aorta descendens, securing by ligature the subclavian and carotid arteries. The Injection by the aorta will be retrograde to the circulation; but we find that, in the dead subject, the valves do not so completely perform their office, as in the living, and that the Injection will in general readily pass into the Heart, though contrary to the natural circulation; but to avoid any risque, they may be perforated or broken down by some proper instrument introduced into the aorta. The air cells are next to be injected by the trachea; this is to be done with great care, for if the Injection is forced beyond a certain degree, it will form extravasations on the surface. The two sides of the Heart, and the air-cells should be injected with different colours, which, when finished, the parts placed in a natural position, and the pipes removed, the preparation may be put immediately into the acid liquor for corrosion, and finished according to the rules already laid down.

ARTICLE XXXII.

Injecting and Corroding the Heart.

A Heart for the purpose of Corrosion need not to be chosen free from fat, as is directed in most other injected preparations of this viscus; for in the present case the heart and vessels are to be destroyed by the acid liquor.

The mode of conducting the process is, first, the Heart being taken out, wash its cavities very clean, taking care that there be no coagulum left: more care is required in this respect, than any other preparation of the Heart. Drain out the water thoroughly, and fix a pipe in the superior cava, to inject the right side, and another in one of the pulmonary veins, to inject the left side of the Heart; then secure the mouths of all the other vessels by a ligature, and inject the two sides of the heart with two different coloured Injections; when cold, remove the pipes, and put the part into the acid liquor for Corrosion, which, when completed, and the preparation washed, gives the exact model of the internal parts of the heart and the large adjacent blood-vessels. This preparation should be varnished and preserved under a glass cover from dust and other injuries.

ARTICLE XXXIII.

Injecting and Corroding the Liver.

For the purpose of making a complete corroded preparation of the liver, it will require four pipes, and as many different coloured Injections. The vessels by which this viscus is to be injected, are, the hæpatic artery coming off from the cæliaca, the vena portæ, the vena cava ascendens, and the ductus hæpaticus, through which the bile is conveyed to the gall bladder. The vena cava on the superior surface of the liver, should be secured by a ligature, after the blood is washed out as clean as possible. The Injection is to be conducted according to the general rules; when this process is finished, remove the pipes, and put the liver into the acid liquor for Corrosion, before the Injection becomes cold and brittle, and never let it be handled till it is perfectly corroded; then let it be washed clean, and when dry, varnished and fixed upon a proper pedestal, securing it from dust and other injuries by a glass cover.

ARTICLE XXXIV.

Injecting the Spleen for Corrosion.

A Spleen chosen for the purpose of Corrosion, should always be very recent, as its texture is soon broken down by putrefaction. This is to be injected by the artery and vein only, having no excretory duct. If the spleen is very fresh, it will shew the extremities of the veins uniformly rounded. The process of corroding, cleaning, varnishing, &c. are described under their proper heads.

ARTICLE XXXV.

Injecting Kidneys for Corrosion.

A Kidney for a successful experiment of this kind, should be in a perfectly sound state, and free from any calculi.

The general intention of injecting the kidneys of the human subject, as well as of other animals, is for Corrosion, as the ramifications of their vessels cannot be so well shown in any other way. This is one of the most simple operations of the kind. There are three orders of vessels to be injected: the arteries, veins, and urinary duct. The artery is distinguishable from the vein, in this as in most other parts of the body, by its greater thickness and elasticity; and also by being generally (in its healthy state) smaller than the vein, which vessel it bears the greatest resemblance to; and the duct, by the enlargement near its entrance into the kidney, it being situated more inferiorly, and in general is much longer than the vein or artery; but this last depends upon accidental circumstances. Proper sized pipes being fixed into the vessels, proceed according to the general rules, to fill each with a different coloured Injection; and after removing the pipes, immerse the kidney in diluted muriatic acid (see page 83) for five or six weeks, or until the texture of every part of the kidney is so thoroughly destroyed, that it may be entirely washed away by a gentle stream of water.

Kidneys for the purpose of injecting, should be removed from the body with care, that neither the part itself, or its vessels, may be in the least degree wounded; as by such an accident the Injection will escape. Neither should we be solicitous to remove the surrounding adeps and cellular membrane, more than may be just sufficient for fixing the pipes, on account of the numerous small branches which are frequently going off from the emulgents into the surrounding substance.

A variety of beautiful and elegant preparations may be made of the kidneys of different animals. The sheep's is very similar to the human in figure and structure; the hog's is more extended than the sheep's; the dog's ramify different from either, and the vessels more superficial; the horse's varies much in its external figure, but makes a noble and beautiful preparation; the cow's differ in figure and structure from either of the former; the tyger's has an order of superficial vessels, beautifully ramifying from the trunk of the emulgent in a radiate direction over those deeper seated. Thus by collecting from different animals, we may form a most pleasing collection.

ARTICLE XXXVI.

Injecting and Corroding Placentæ.

A Placenta chosen for this purpose, should have large vessels, and the substance of it should be entire and not torn, so as to admit the Injection to escape; particular care should be taken that the arteries and veins are washed very clean from blood, and the water forced out of them again, by throwing in repeatedly a syringe full of air: the vessels should be particularly well injected for the purpose of Corrosion; for if there are only one or two breaks or separations of the Injection in any of the larger branches, by means of blood or water remaining in the vessels, or by any other cause, it will render it unfit for this particular purpose; and in such case it may be made a different preparation of, as described in Article XI. and with this view the membranes ought always to be preserved until it is seen how we succeed with the injection; which is to be performed in the same manner as directed in the above Article. If the Injection has succeeded, then place the umbilical chord in such a position, as will be least inconvenient when the preparation is finished, for it cannot well be placed after it is corroded. It should be then put into the acid liquor, before the Injection becomes cold and liable to break; to guard against this, let it be handled as little as possible. We should not attempt washing it until it is completely corroded, and then handled with the greatest caution; for this is a preparation of all others most liable to be destroyed by the smallest accident; to guard more effectually against which, it should not be taken out of the vessel in which it is corroded, until it is completely washed; for the hands cannot easily support uniformly so broad a body; so that the weight of such parts as are not properly supported, will be liable to break the vessels, the surrounding fleshy parts having lost all their strength, by being reduced to a pulp.

ARTICLE XXXVII.

A Corroded Preparation of the Penis.

NOTHING more need be said upon the subject of injecting the Penis for Corrosion, than what is already given in Article XV. as the Injection will in every respect be the same; when this is done, the part is to be put in the muriatic acid, until all the cuticular and membranous parts are fully destroyed; then it is to be removed from the acid, and washed as other corroded preparations, taking particular care not to break the vena magna, or any of its branches.

ARTICLE XXXVIII.

Injecting the Pancreas for Corrosion.

THE duct is all that can be readily injected in this viscus; it may be found entering the duodenum with the ductus communis, but in some instances a little below it; the part being carefully removed from the body, fix a pipe of the proper size in the duct, and conduct the Injection as usual.

To this gland we have no proper artery or vein, it being supplied only by branches from the splenic vessels; for which reason it is difficult to preserve by corrosion more than the excretory duct, unless we inject and corrode the splenic vessels with it.

PREPARATIONS BY MACERATION.

ARTICLE XXXIX.

Preparing the Cancelli of Bones.

PREPARATIONS of this kind are made from the cylindrical bones; generally the os femoris, being the most complete cylinder; and the middle portion of the bone only should be used, where the Cancelli is the most delicate; this part should be cut into portions of about two inches in length, with a fine saw; the bone should be so steadily fixed as not to injure the Cancelli by the jarring of the saw; then lay the pieces in clean water to macerate for two or three months, or until the oil has all escaped from the cavity; then dry them, and the reticulated delicate structure of the Cancelli will appear beautifully distributed through the cavity. These preparations should always be made of recent bones, and handled with great care, as by a fall the beauty of the preparation will probably be destroyed.

ARTICLE XL.

Separating and Preserving the Chirotheca, or Cuticle of the Hand, and Podatheca, or Cuticle of the Foot.

THESE preparations are easily made; and for this purpose, the hands and feet of infants only should be used, on account of the cuticle being more equal in its thickness, and easily managed. For this purpose, we generally separate the hand by a transverse section half way, between the wrist and elbow; and the foot half way, between the ancle and knee; then lay them in clean water: if it becomes bloody, let it be changed daily, until it receives no more colour; afterwards suffer them to remain until putrefaction takes place, to such a degree as will entirely loosen the cuticle, when it may be easily slipped off, by grasping the arm or leg with one hand, where the section is made, so as to draw down the cuticle with the other, in the manner we frequently slip off a stocking; it should then be thrown into clean water to wash it, and get out the folds it is thrown into in slipping it off; then remove it carefully from the water, by taking hold of the fingers or toes, so that the water may run out, otherwise its weight will tear it to pieces; afterwards put it in a glass, half filled with diluted spirits of wine (one part spirits, and two of water) and by means of a tube introduced carefully to the inside of the preparation, pour in more of the diluted spirits, and distend it so as to give it a natural figure, and by this means fill the glass. These preparations being so light and delicate, scarcely require any suspension; and when they are suspended, will frequently, by turning the glass about, tear from the thread.

ARTICLE XLI.

Preparing the Air Vessels of the Lungs by Maceration.

THE ramifications of the bronchiæ may be exhibited in a preparation made by Maceration; for this purpose, the lungs of a dead-born child should be procured; but those of a slink calf will be found to answer better than any other. This process is very simple, though in some respects not very agreeable to the olfactories, like many more of our anatomical employments: first, macerate the lungs in water, until they become sufficiently putrid to break down the texture of the blood vessels, cellular membrane, &c. which should be washed away with the finger and thumb, whilst the preparation is held under water, changing the water frequently, as it becomes thick and turbid with the pulpy matter which washes off, that it may be seen when the ramifications of the bronchiæ are sufficiently freed from all surrounding matter; then put it into spirits of wine, diluted with an equal quantity of water.

ARTICLE XLII.

Cleaning and Preparing Bones in general.

As much of the fleshy parts should be taken from bones intended for preparation, as can conveniently be done; but it is not necessary they should be separated from each other, more than is required for the convenience of placing them in a vessel, for the purpose of maceration, as in this process it will readily take place. The bones are to be laid in clean water, of such a depth as entirely to cover them, which water should be changed every day, for about a week, or as long as it becomes discoloured with blood; then permit them to remain without changing, till putrefaction has thoroughly destroyed all the remaining flesh and ligaments; this will require from three to six months, more or less, according to the season of the year, or temperature of the atmosphere, &c. In the extremities of the large cylindrical bones, holes should be bored, about the size of a swan's quill, to give the water access to their cavities, and a free exit to the medullary substance. As by evaporation the water will diminish, there should be more added, from time to time, that none of the bones, or any part of them, may be suffered to remain uncovered, as by exposure they would acquire a disagreeable blackness, and lose one of the greatest ornaments of a skeleton—a fine, white, ivory complexion. It will be necessary, in order to preserve the skeleton as clean as possible, especially in London, and other large cities, where the atmosphere abounds with particles of soot and other impurities, to keep the macerating vessels always closely covered; as from neglect of this, the water will acquire so much of it, as to blacken the bones. When the putrefaction has destroyed the ligaments, &c. the bones are then fit for cleaning; this is done by means of scraping off the flesh, ligaments, and periosteums; afterwards they should be again laid in clean water for a few days, and well washed; then in lime water, or a solution of pearl-ash,* for about a week, when they may be taken out to dry, first washing them clean from the lime or pearl-ash. In drying bones, they should not be exposed to the rays of the sun, or before a fire, as too great a degree of heat brings the remaining medullary oil into the compact substance of the bones, and gives them a disagreeable oily transparency; this is the great objection to boiling of bones, for the purpose of making skeletons, as the heat applied in that way has the same effect, unless they are boiled in the solution of pearl-ash, which some are of opinion, is one of the most effectual methods of whitening them, by its destroying the oil. Bleaching is of all methods the most effectual, where it can be done to its greatest advantage, that is, in a pure air; and more especially on a sea shore, where they can be daily washed with salt water.

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* Solution of pearl-ash for this purpose is made in the proportion of two ounces of pearl-ash to a gallon of water.

ARTICLE XLIII.

Making the Natural Human Skeleton.

NATURAL Skeletons are made without any separation of the bones from each other, in which the natural ligaments remain; these are generally made of very young subjects: but the ligaments, when dry, not having their natural flexibility, is an inconvenience in this kind of skeleton, as the different kinds and extents of motion cannot be shewn in the several articulations.

In making these, we are first to remove from the bones, the cutis, muscles, tendons, viscera, and every thing except the connecting ligaments and cartilages, which should be carefully avoided; this may be done without any regular order of dissection: neither in this part of the process, need any attention be paid to making the bones clean. The brain may be removed, through an opening in the large fontanel, if the subject is very young, if not, a perforation may be made with the trephine for that purpose. This being done, lay it in clean water, changing it every day, as long as it receives any tinge of blood from the skeleton; then let it remain until putrefaction has so far advanced, as that the soft parts may easily be separated from the bones, when it may be dissected away with a knife, scissars, and forceps, taking care not to injure the ligaments: this being done, lay it in water for a day or two, to get it perfectly clean from any colouring matter; then remove it into clean lime water, or solution of pearl-ash, for two or three days, to take off any greasiness, and give it a more beautiful white; when it has laid long enough, wash off, with clean water, all the lime that adheres to the surface. When the preparation is thus cleaned and whitened, hang it up to dry, or dry it in a frame, calculated to preserve the posture we wish it to be fixed in. It will be necessary to remove the arms from the trunk, and when cleaned, to fix them on by a slender annealed iron wire.*

It must be remembered, if the preparation is suffered to remain too long in the water, the ligaments themselves will be destroyed by putrefaction, and the intention defeated.

ARTICLE XLIV.

Cleaning and Separating the Bones of the Head.

A Distinct article seems here necessary, as in the preceding, on preparing the Artificial Skeleton, the manner in which the bones of the head are separated is not described, it being effected in a way peculiar to itself, and with a view to ascertain the variety of bones which form the head, their number, names, proportionate size, figure, relative situation, &c.

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* Wire rendered soft and pliable, by being made red hot, and suffered to cool again.

To clean these bones, make numerous incisions through the scalp and other soft parts, and macerate the head in water, changing it every day, until it no longer receives a bloody tinge; then suffer it to remain until putrefaction has proceeded so far, as that the fleshy parts and periosteum will easily separate: these should be scraped off with a knife: the brain will readily wash away, by the foramen magnum, if its texture is first broke down with a stick, introduced through that aperture. The head being perfectly cleaned in this way, must be filled with dried peas, well shaken in, so that as many may be introduced as possible; in this state it is to be laid in water, so that by wetting and swelling the peas, the most uniform pressure may be applied to the internal surface of the cranium, which will gently separate the principal bones at the sutures: after which the other separations may be easily effected by the hand. But it should be remembered, that in old persons, the sutures are generally obliterated, when a firm ossific union takes place, very unfavourable for this purpose; so that a head, whether prepared with this intention, or to be preserved entire, to shew the several bones and sutures, should be from a subject of about twenty years of age, at which period the bones are the whitest, and the sutures most perfect; besides, the teeth are often in very good condition, which is a great ornament to the entire preparation.

The bones should be whitened, if necessary, as described in Article XLII.

ARTICLE XLV.

Cleaning and Preparing Diseased Bones.

DISEASED and healthy bones are cleaned much in the same way; but particular care is necessary in respect to the former. The surrounding soft parts are to be removed with the greatest caution, and the edge of the knife is not to be carried so deep as to injure the fine spungy parts of the bone, which in some diseases proceed a considerable distance from its original line; then macerate them, changing the water daily, as long as it is reddened; after which, let them lay till the fleshy parts are entirely destroyed by putrefaction; this process will take up, in some cases, five, eight, or ten months, especially if the weather is cold; then wash away the soft parts by a stream of water, in the manner of cleaning corroded preparations. The bones being perfectly cleaned, whiten them in alum water, or the solution of pearl-ash (see page 100) and then dry them.

These preparations require considerable care, as they are easily crumbled to pieces; therefore should always be enclosed in a glass vessel, to prevent their being handled, or exposed to dust.

ARTICLE XLVI.

Natural Skeletons of Fish, Quadrupeds, Birds, &c.

THE method of making these skeletons is so similar to that of the human natural skeleton (see Article XLIII.) that very little need be said on the subject; in all animals, except very small ones, they may be managed exactly the same. Mice, small birds, &c. may be put into a box, of proper size, in which holes are bored on all sides; and then buried in an ant-hill, when the ants will enter numerously at the holes, and eat away all the fleshy parts, leaving only the bones and connecting ligaments; they may be afterwards macerated in clean water for a day or two, to extract the bloody colour, and to cleanse them from any dirt they may have acquired; then whitened by lime or alum water, and dried in frames, or otherwise, as may be most convenient. In country places, I have sometimes employed wasps for this purpose, placing the subject near one of their nests, or in any empty sugar cask, where they resort in great plenty; they perform the dissection with much greater expedition, and equally as well as the ants. I have seen them clean the skeleton of a mouse in two or three hours, when the ants would require a week.

EXPLANATION OF PLATE V.

Representing the Skeleton Cradle.

This machine is intended for drying natural skeletons, or subjects prepared for the blood-vessels, more particularly of quadrupeds, in any position; it consists of a plank, bows, rods, and lath.

A A. The Plank.
B B B B B B B. The Bows.
C C C C C C C. The Rods.
D D. The Lath.

These machines may be made of different dimensions, and the number of bows according to the length of the plank. The plank should be made of considerable thickness, the bows of some elastic wood, and each end fixed in the plank, near the edge, by a mortise and tennant, confined by a moveable iron pin, which goes through the edge of the plank into the feet of each of the bows, to keep them in their places, as shewn in the plate; these should be made to take in and out at pleasure, as more or less of the bows may be required on different occasions. The bows should be placed about six inches from each other; and in the perpendicular part, on each side, are to be made ten or twelve holes, at equal distances from each other, large enough to pass the wooden rods as represented in the plate.* The lath is of equal length with the

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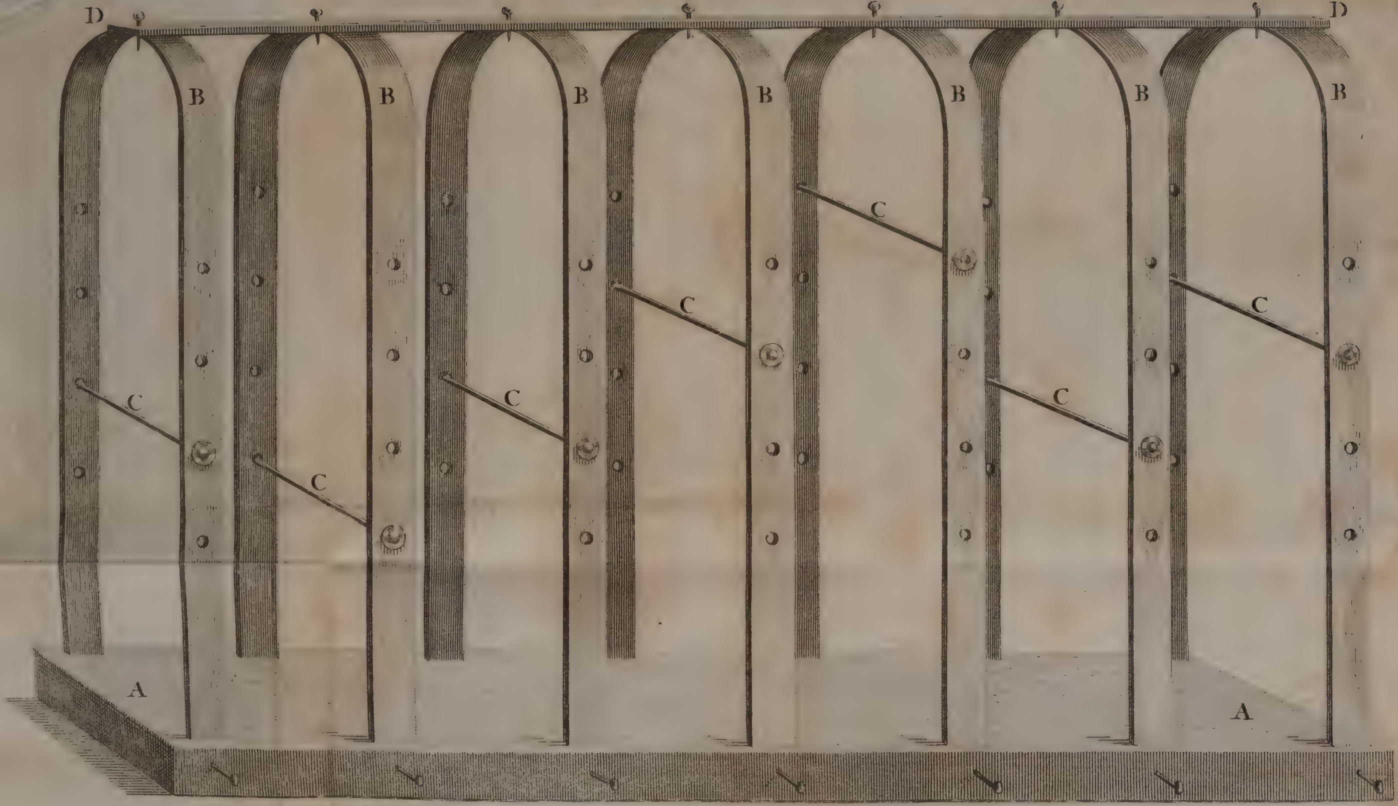
* N. B. The holes in the bows represented in the plate, are not close enough to each other, by about one half.



Wm Darton & Co. ſc.

plank, and is fixed on the top, in a transverse direction to the bows, to each of which is fixed by a wooden pin passing through it and the centre of the bow, for the purpose of keeping them steady, and at their stated distance from each other.

The size of these machines may vary, according to the intention or purpose of the Anatomist.

The manner of placing quadrupeds in the cradle, for the purpose of drying them in any particular position, is to fasten the feet upon the plank, by a few small nails or tenter-hooks driven into the plank; then suspend the body, head and tail, by cords, from the lath, or by rods, placed so that the spine may rest upon them. If one or more of the feet are required to be elevated, it should be put in that posture, and supported by one of the rods.

The Human Skeleton requires but very little ingenuity to keep it in a proper position, as suspending it by the head, every part will fall almost into its natural posture; but this machine may be useful to preserve any other attitude, which may be desired, by a very little contrivance.

No further description will be necessary respecting the management of blood-vessel subjects, as the same remarks will apply in both cases.

PREPARATIONS BY DISTENTION.

ARTICLE XLVII.

Observations on distending hollow Preparations by Spirits of Wine.

THE intention of distending preparations by spirits, is either to give them their natural figure, or to exhibit more fully the parts of which they are composed, or occasionally some morbid or preternatural appearance. The parts most commonly prepared in this way are the lungs, intestines, urinary bladder, biliary cyst, corpora cavernosa, and spongiosa of the penis, chirotheca, podatheca, ovæ, hydatids, &c. these when distended, are to be immersed in spirits for a few days or a week, when they will acquire a considerable degree of hardness, and be disposed to keep the form given them by the Distention; after which, any part may be removed, or opening made, to shew their internal structure, or peculiar appearance, for which the part may have been preserved; the preparations are then to be properly suspended in a glass vessel of clean spirits.

It is to be remembered, that the rectified spirits of wine only is used for these purposes, on account of its strength, perfect transparency, and being perfectly free from all colour.

ARTICLE XLVIII.

General Observations on distending hollow Preparations with Air, Hair, Wool, Cotton, &c. for Drying.

THERE are many parts which require to be distended, in order to drying them in their natural form, such as bladders, hydatids, intestines, large blood vessels, &c. and where the nature of the case will admit of it, air is always the best, as the Distention is more uniform; but for Inflation it requires that the parts should be entire, or nearly so; if it should have small holes, they may be secured by passing a pin through the edges, and making a ligature round the pin; the pin prevents the ligature from slipping off, without including a considerable portion of the preparation; the points of the pins should always be cut off as soon as the ligature is made, with a pair of nippers, to prevent their making more holes in the neighbouring parts, when it may be cautiously distended: if it should be injected, sometimes the injection is so hard as to break into innumerable pieces, especially in very cold weather, to prevent which, it may first be put into warm water to soften it, and render it more ductile.

When parts requiring Distention, for the purpose of drying them in their natural form, will not admit of inflation; such as are large, or of considerable substance, as dropsical ovariæ, large arteries, aneurisms, uterus, &c. they may be distended with curled hair, such as is commonly used for stuffing chair bottoms, and may be had of the cabinet-makers; for more delicate preparations, we may use wool or cotton, which should be sufficiently oiled *, to prevent it sticking to the part: in this condition they may be hung up in a current of air to dry; afterwards the hair, wool, or cotton, should be removed as clean as possible, and the preparation varnished.

ARTICLE XLIX.

Distending hollow Preparations with Plaster of Paris.

PARTS may be distended with Plaster of Paris, where either its removal is not afterwards necessary, (as is generally intended, when quicksilver, tallow, &c. are used) or where the quantity required is so large, as to render it too expensive to distend with Injection, as in case of distending the bladder, stomach, dura mater of the brain, intestines, &c. The intention of filling such parts with Plaster, is, in some instances, merely to give their natural figure in others, a sufficient firmness and resistance for the convenience of making models, to shew their external figure. Plaster is particularly convenient, where winding canals prevent the use of wool, hair, &c. or where the part is so thin as to assume a rough, irregular, and unnatural surface, from the unequal Distention of the latter;

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* The oil should be put upon the wool before it is carded, as carding is the best way of distributing it equally.

and it may be used with less inconvenience than any other fluid material, when the parts have been lacerated and sewed together again, being less disposed than air to escape between the stitches. Thin injected preparations are also distended with it, to shew the distribution of blood-vessels upon the white ground; but the various purposes for which this material may be employed, every man's own ideas will suggest, when he becomes a little familiar with its use.

For the purpose of distending preparations, it should be mixed particularly well, so as not to be lumpy, and rather thinner than for the common purpose of casting, so that it may run freely into all parts; and if it is to pass through the fine tubes, as in distending the lungs, the mixture ought to be strained through a cloth with open threads suitable for the purpose; but it should all be done as quick as possible, or it will soon harden, and frustrate the intention.

Previous to pouring in the plaster, the part should be made as clean as possible from blood, air, or water, and whatever else may disfigure it: the plaster should be mixed in a glazed vessel, and poured through a paper funnel into the part; the objection to the common tin funnel, is, that the plaster, when hard, does not so easily come off, and soon destroys it by rust: when there is a sufficient quantity introduced, secure the orifice by a ligature, and if the mixture has not passed equally, move it with the hand, and gently shake it, so as to make it run into all parts before it loses its fluidity. In distending the lungs, and such parts where the tubes through which it is to pass, are very small and numerous, it is necessary to force the plaster with a pipe and bladder, in the manner of injecting clysters; but in this operation, two circumstances should be attended to; first, to exclude all the air from the bladder before we inject, and secure it by a ligature; in the next place, always to have enough of the plaster mixed to completely fill the part, without mixing a second quantity, as so much time would elapse, that the first quantity injected would begin to harden before the second is thrown in, by which the second would not pass, and the part be partially and imperfectly filled: but this inconvenience would not follow a second mixture, where there are one or more large open cavities, having no immediate communication with each other, as in the heart.

ARTICLE L.

A dry Preparation of the Penis, with the internal Organs of Generation, Urinary Bladder, &c.

FOR this preparation, the penis, urinary bladder, prostrate gland, and vesiculæ seminales, a portion of the ureters, and vas deferens should be removed from the body, without wounding the parts to be preserved: what regards the Injection of the Penis, is giving in Article XV. But if the blood-vessels are injected in situ, the preparation will be more complete, as those in the urinary bladder, &c. will then be filled. The fluids contained in the vesica urinaria, and vesiculæ seminales being pressed out, these cavities may be inflated;

the former by the ureters, both of which should be distended; the latter by the vas deferens; or these may be distended by quicksilver, until the preparation is dry, and then evacuated by puncture: this being done, the preparation should be suspended, with the several parts in their natural relative situations, and when dry, be properly varnished.

ARTICLE LI.

A Preparation of the Penis, to shew its Internal Structure.

FIRST inject the arteries of the penis with coarse red Injection, by pipes fixed into the internal pudendal arteries, running on the inner side the branch of the ischium, both to the right and left; then remove the penis from the body, as directed in page 112, and the further process, in respect to injecting, is as there described, with this difference only, that quicksilver is to be used instead of the coarse Injection; this being finished, macerate it in water until the cuticle will peel off, then the part is to be suspended in the air until thoroughly dried; after which, with a sharp knife, remove two lateral portions of the penis, extending from the glans to the extremities of the crura, sufficient to give a full view of the internal parts; two lateral portions are in like manner to be removed from the glans. These apertures will give a free exit to the quicksilver, and better exhibit the internal parts; the preparation becoming transparent when immersed in oil of turpentine, its cellular structure, and the ramifications of the arteries through the corpora cavernosa, will be very evident.

ARTICLE LII.

A Dry Preparation of the Heart, to shew its Cavities, Valves, Chordæ-Tendineæ, &c.

A Heart for this purpose should be chosen free from fat; it is not necessary to preserve any considerable length of vessels; the cavities, &c. are all to be well washed out, and the part macerated in water for several days, or as long as may be, without weakening the vessels by putrefaction, that when finished, it may be as transparent as possible. When it has been macerated for a sufficient length of time, tie up the extremities of the vessels, first fixing a pipe in the superior cava, entering the right auricle, to fill the right side of the Heart, and another in one of the pulmonary veins, entering the left auricle, to fill the left side; then inject with melted tallow, after which it is to be suspended in the air until perfectly dry; but it is necessary to remember, that the internal parts remaining moist long after the external appear dry, it will be safest to let it hang for several weeks, even in very drying weather. The next part of the process is to cut off the extremities of the vessels, and make such openings into the auricles and ventricles, as will afford the best view of the internal parts; then place it at a proper distance from the fire, and in such positions as may be best adapted for melting and draining out the tallow from the cavities and vessels; this should be carefully and thoroughly done, taking care not put it so near the fire as to injure the preparation; afterwards it is to be varnished with the white spirit varnish, this more readily drying on greasy surfaces.

ARTICLE LIII.

Preparations of the Lungs in Spirits of Wine, or Oil of Turpentine, to shew their Air-Cells and Vascularity.

THE air-cells in the lungs of amphibious animals, are much larger than in those of others, and therefore the most beautiful preparations of this kind are made of the lungs of the sea turtle; and these will be much improved, by filling the pulmonary arteries and veins with red coloured minute Injection; afterwards immerse the part in a vessel containing spirits of wine, sufficiently large to receive the expanded lungs without compression; and whilst in the vessel, inject into them by the trachea, such a quantity of the above spirits, as will fully dilate them without danger of rupture; this is to be confined in the cells by ligature on the trachea; let the preparation remain for a few days, after which, with a long and very sharp knife, make a longitudinal and even section, by which the largest branches of the bronchiæ may be equally divided; this will give the spirits a free opportunity to escape from the cells. It should not be handled or pressed more than is absolutely necessary, as pressure will tend to close up the cells; it is then to be suspended in a glass vessel of rectified spirits; in this way it affords not only a view of the air-cells, but also of the extremely minute vascularity.

The lungs of any other animal may be prepared in this way; but those of the amphibious kind are generally preferred for the reasons first mentioned.

When the lungs are to be preserved in oil of turpentine, the process is varied in the following manner: the pulmonary arteries and veins being injected as before, the bronchiæ may be distended with quicksilver, if they should be very small; but the larger kind would require a much greater quantity than they could sustain the weight of without rupturing: this is to remain in the air cells until they are thoroughly dry, which requires a considerable length of time; and to prevent putrefaction, they should be previously laid in spirits of wine for a few days. When dried, make a section longitudinally, as before described, to permit the quicksilver to escape, then preserve the part in a glass vessel of oil of turpentine.

Lungs too large for Distention by quicksilver, may be filled with air, though this is apt to escape from the vessel when distended to too great a degree; if they will retain the air, it is much the most convenient mode of filling them for the purpose of drying; when effected, make a longitudinal section, as before described, and preserve the portions in fine oil of turpentine. Longitudinal and transverse slices of the lungs thus dried, shew the cells in different ways. The lungs thus prepared, and preserved in oil of turpentine, are rendered transparent, by which their vascularity is much more easily seen

ARTICULATION.

ARTICLE LIV.

Of Articulating the Human Adult Skeleton.

ARTICULATION, in this sense, is the artificial union of bones, so as to admit the several kinds, and the same extent of motion in each joint, as performed by the living animal.

The human adult skeleton only is the subject of this article; but the same rules equally apply to the bones of quadrupeds, &c.

Having previously cleaned and whitened the bones according to the directions already given in Article XLII. let them be thoroughly dried, then arranged upon a table, or some convenient place, to facilitate the proper application of them, and to avoid errors in the Articulation.

First, the lower jaw is to be fixed in its natural situation by slender wires passed through its condyloid processes and each temporal bone, so as to bring the articulatory surfaces into contact; the wires should be so loose as to admit the motions of the jaw, but as without some other support, the anterior part would drop, and give an unnatural appearance, it is to be kept in its situation by a spiral wire, in the form of a bell-spring, having one end fastened to the os sphenoides, and the other to the middle of a wire stretched from one angle of the jaw to the other; this will act as a spring to keep the jaw in its natural posture, and at the same time admit of occasional depression: some use a flat steel spring, with one end rivetted to the os sphenoides, and the other pressing upward under the symphysis of the jaw; but in this case an horizontal section of the cranium must be made, to carry the rivets through the sphenoid bone, and the portion of the cranium thus divided, may be fastened in its situation by means of a brass tea-chest hinge, fixed by rivets on the posterior part of the head, so as to admit the upper portion to be raised for occasionally inspecting the internal parts.

The first cervical vertebra, called the Atlas, is then to be fixed by means of wires passed through it and the basis of the occipital bone, in any way that may best confine it in its natural situation, as no motion is here required between this and the other parts to which it is thus united. A strong wire is then to be placed across the aperture, so as to form in its anterior part a circle sufficient to admit the end of the little finger; through this circle the upper extremity of the large wire is to pass, upon which are strung the other vertebræ.

In the next place, all the cervical, dorsal, and lumbar vertebræ are to be strung in their proper order upon the wire, which should be about the size of a small goose-quill; and is to be incurvated according to the natural direction of the spine; this must pass through the centre of the body of each vertebra, by means of holes bored for the purpose; its lower extremity is to enter the sacrum, and be confined by a pin driven from its inner surface, about an inch from the top, so as to pass into a hole previously made in the wire to receive it. Between the bodies of the several vertebræ, for about ten or twelve joints above the sacrum, are to be interposed thin circular pieces of cork, to imitate the natural cartilaginous substance, which separates from each articulatory surface, in the previous maceration of the bones; otherwise the spine would look unnatural, and the skeleton be considerably shortened: these pieces of cork should be about three-eighths of an inch thick anteriorly, and those parts sloped off in the form of a wedge, which lie next to the spinous processes: this thickness is adapted to the interstices of the lumbar vertebræ; but should lessen gradually as they advance upward, until they are scarcely the eighth of an inch; they should be made larger than the circumference of the bodies of the vertebræ, and when the spine is completely articulated, the edges should be cut away, to reduce them to a proper size; after which they may be covered over, and any remaining inequalities filled with a composition of flour and water, slightly coloured with a small quantity of burnt umber: this should be mixed to the consistence of soft Glazier's putty, and the parts to which it is to be applied previously wetted, that it may stick the better. The joints being thus filled, the spine will have a much neater and more natural appearance. The upper extremity of the wire passed through the vertebræ, is to be left sufficiently long to go through the circle made by the wire in the atlas, and through the foramen magnum, above the superior part of the cranium, in which situation it must be confined by a nut screwed upon the top of the wire close to the bone: but when the horizontal section is made, and the superior portion fixed by a hinge, another method should be observed; in this case the large wire upon which the vertebræ are strung, is only to extend about an inch and a half into the cavity of the cranium, and having a small hole near its upper end, a slender wire is to be brought through a hole in the summit of the cranium, and fastened to it; in the upper end of this slender wire should be formed a loop or ring for the purpose of suspending the skeleton when finished. The wire passed through the cranium being pliable and yielding, will permit the superior portion to be moved up and down at pleasure.

The ribs are all to be united to the transverse processes of the dorsal vertebræ, by slender wires passed through their posterior extremities, and those processes, in such manner as will best confine them in their natural situation, without regard to preserving any motion: in doing this, it will be found most convenient to articulate the lower ribs first, on each side, and so advance upward; for as the ribs are pointing obliquely downward, they will incommode the person, and there will be a danger of their being broke if this rule is not observed.

When the ribs are thus articulated to the spine, their anterior extremities are to be supported with narrow slips of Sadlers skirt-leather, in imitation of their natural cartilaginous appendages, by which they are connected to the Sternum; these slips will vary greatly in respect to their length, as those coming from the tenth or eleventh rib will require to be in some subjects eight or nine times as long as those connecting the first and second: but the peculiar figure of these, their various lengths, &c. will be easily understood by referring to a good drawing or plate, giving an anterior view of the skeleton. The manner of fixing these to the ribs, is to make a perpendicular slit with a saw, in the extremity of each rib, about half an inch deep, then cut the ends of the leathern slips sufficiently thin to enter the slits, in which they are to be secured by glue, or by a pin passed anteriorly through the extremity of each rib, so as to go through the ends of the leather: these pins are to be cut off close to the bone on each side; the other extremities are to be fixed in the sternum, by holes made in both edges opposite to each other, in the parts to which the natural cartilages were attached; into these holes the extremities of the slips are to be introduced, and fastened by glue or pins, in the same manner as they are fixed to the ribs. The slips are to be covered over with the paste before mentioned, to give them a more agreeable appearance.

The Clavicles are to be articulated with the sternum by means of a slender wire passed through each in any direction, so as to confine them in their natural situation; though some articulate them in the same manner as the bones of the fingers, hereafter described. Their superior extremities may be articulated to the acromia of the scapulæ in the same manner as to the sternum; but, as little motion is required in those parts, I think it is as well to connect them by wires only.

The Scapulæ being articulated to the clavicles, may be loosely connected with the trunk by means of slender wires passed through their inferior angles and the ribs, situated immediately anterior to that part, and the superior angles may be connected to the second ribs in like manner; for as they have no natural articulation with the bones of the trunk, otherwise than by the clavicle, these connections are necessary to preserve their proper situations, and give them a degree of steadiness, which will more effectually secure them from accidents.

The Bones of the Pelvis may be articulated in the following manner; the two ossa ilei, to the lateral edges of the os sacrum, by means of two strong wires passed through the outside of the posterior part of the ileum from side to side, so as to pierce the thick part of the sacrum, one about an inch, or an inch and a half above the other; and upon the ends of each wire is to be placed a nut, half an inch in diameter, and secured by a screw, or rivet. The symphysis of the ossa pubis may be connected in the same way, by one or two wires passed through from side to side in a lateral direction, and secured by rivets. A piece of cork, a quarter of an inch thick, or not quite so much, may be placed within the symphysis, as a substitute for the natural cartilage lost in the maceration: this should be covered with the paste in like manner as the joints of the spine. The os coccygis should be articulated with the lower extremity or apex of the sacrum by a tin plate and two pins; as the bones of the finger hereafter described.

The head and trunk being finished, the next to be described are the Extremities, and the first in order are the superior. The humerus is to be articulated to the scapula in the following manner: make a longitudinal oblique incision with a saw, through the head of the bone, about an inch deep, in which a screw (about two inches and a half long) is to be fixed; the upper half of the screw should be made flat, with a hole near the top to receive a wire, which is to be passed laterally through the head of the bone, to secure it in this situation, and admit it to be moved freely upward and downward in the incision, in the manner of a fixed lever: the part of the screw projecting from the articulatory surface is then to be screwed into the centre of the glenoid cavity of the scapula; but as the bone in this part is of too soft and spongy a texture for the screw to retain its hold in, a square brass nut must be introduced into the substance of the bone, a quarter of an inch behind the glenoid cavity, so as to receive the screw fixed in the head of the radius. This nut is to be introduced by a small mortice cut from the inner surface, or that part of the bone next the thorax, and afterwards filled up with the paste before mentioned. This kind of articulation will admit every motion performed by the living subject, and the extremity may be removed from the trunk any time, if necessary, by screwing it on or off.

The elbow is one of those joints which are articulated with the tin plate and pins. A circular piece of tin plate, near an inch in diameter, is to be fixed firmly in a longitudinal direction, into the ridge of the semicircular notch, formed by the curvature of the olecranon of the ulna: this plate should be fixed in the bone edgeways, and kept in its situation by two pins passing through it and the bone from side to side; the projecting part of this tin is to be received into a slit, made with a saw, in the deep groove in the middle of the lower extremity of the humerus, in which it is to be confined, so as to move freely in the manner of a hinge, by means of a pin passed laterally through the joint, in the centre of its motion, and through a hole made in the place to receive it.

The upper extremity of the Radius is articulated to the anterior process of the ulna, by a small oblong piece of tin plate, one end of which is firmly fixed in the outer surface of the process, in a transverse direction, the projecting end is received into a transverse incision in the lateral articulatory surface of the radius, made with a saw, about a quarter of an inch from its upper extremity, in which situation it is to be confined by a pin, passing longitudinally in the extremity of the bone, through the tin plate as a centre of motion. The lower extremity of the ulna is articulated to the radius, in a manner exactly similar to the former; the plate is to be fastened transversely in the lower extremity of the radius, where it articulates with the ulna, and the projecting end received into a transverse incision in the lateral articulatory surface of the ulna, and confined by a pin passing into its extremity, and through a hole made in the plate to receive it, so that these two joints may admit of the motions performed by the living subject.

The two Bones of the Wrist, which articulate with the radius, are connected to it by two oblong pieces of tin plate, secured by pins as before described: these plates are to be placed in a direction which will admit of flexion and extension.

The carpal and metacarpal Bones are to be connected by slender wires passed through them in any direction, so as to confine them in their natural relative situations, without regard to giving any great freedom of motion.

All the bones of the Fingers and Thumbs are to be articulated by small oblong tin plates, of proper sizes; each plate is to be firmly fixed in the upper extremity* of each bone, by a pin passing laterally through the bone and tin plate, so as to admit of flexion and extention. These plates are all to be let into the extremities of the bones by slitting them to a proper distance longitudinally with a saw.

The lower Extremities are to be articulated to the pelvis as follows: make a slit with a saw through the head of the femur, as far as its neck, in a direction longitudinal with the bone, in which a screw, two inches and a half long, flattened one half its length, is to be fixed by a transverse pin, passed through the head of the bone laterally into a hole made near the flat end of the screw; the projecting end is to pass through a perforation in the centre of the acetabulum, and confined by a nut screwed on the end, within the pelvis, not so close to the bone as to prevent the femur being moved freely to as great an extent as in the living subject.

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* The extremity toward the elbow.

The lower extremity of the Femur is to be connected to the upper extremity of the tibia, by a slip of tin plate, about four inches long, and three quarters of an inch broad; this is to be doubled across its middle, so as to bring the two ends even: the inner surfaces of the tin are to be closely applied to each other, except at the bend, where an open loop is to be formed, for the passage of a wire about the size of a crow-quill: the two extremities of this tin plate, are to be inserted perpendicularly into the posterior edge of the articulatory surface of the tibia, so as to project from the bone about one inch, that the loop may be situated transversely between the two condyles of the femur, when the bones are placed in their natural relative situation; they are then to be connected by passing a wire transversely and laterally through the condyles, near their posterior surfaces, and through the loop of the tin plate. That part of the plate inserted into the tibia, is to be secured by two pins driven into its posterior surface, so as to pierce the plate in two different places.

Another, and I think a better method of articulating these bones, is by means of two tin plates about two inches long, to be driven perpendicularly, about half its length, into the centre of the two oval articulatory surfaces of the tibia, upon which the two condyles of the femur move. These plates are to be secured steadily in this position, by two pins passed laterally through the bone and the plates in two different places; the projecting ends of these plates are to be let into the two condyles of the femur, by means of slitting them with a saw in the direction of their articulatory surfaces; then a pin is to be passed through the condyles laterally, and a hole made near the upper extremity of each plate for that purpose; thus the joint will be in the manner of a Carpenter's rule, and is called the rule joint.

The Patella is to be connected to the superior extremity of the tibia at its anterior edge, by a tin plate about two inches long, and a quarter of an inch broad, which is to pass upward into the inferior edge of the Patella, and downward into the superior extremity and anterior edge of the tibia, and secured by a pin driven into the bones in such a direction as to pierce the tin plate; or it may be connected to the femur in the following manner, and which is a more natural connection: make a slit with a saw posteriorly, and perpendicularly in the ridge of the internal surface of the Patella, and a corresponding slit in the groove in the lower extremity of the femur anteriorly, in which the Patella moves in the living subject: then a slip of tin plate is to be introduced between the two bones, one end of which is to be secured in the Patella by a pin, passed laterally through the bone, and a hole previously made in the plate; and then in the femur, by a pin passed through it in the same manner: by this means the Patella may be moved up and down, and is a better imitation of its natural action in the living subject.

The Fibula may be connected to the tibia at its two extremities by two oblong pieces of tin plate, fixed into four perpendicular slits, made with a saw, through the centre of each articulatory surface, and secured by transverse pins passed anteriorly through the bone and tin plates, as hath been already described: or as the bone requires no motion, it may be connected by pins only, passed laterally through the fibula into the tibia, and secured by clinching their points.

The lower extremity of the Tibia is to be united to the astragalus, by a tin plate let into each by two perpendicular slits with a saw, and secured by two transverse pins passed laterally through the Tibia, and another through the astragalus, and a hole in each end of the tin plate, so as to allow its natural flexion and extention.

The Os Calcis may be united to the astragalus by wires passed from one to the other in any direction most convenient, and that may best secure them in their natural situations.

The Scaphoides may be united to the anterior surface of the astragalus, by wires in like manner; the other bones of the tarsus may also be joined by the same method, as it will not be necessary to give them any motion by a more complicated and troublesome mode of union, though they are sometimes connected by tin plates and pins.

The metatarsal bones may be connected to their corresponding tarsals by wires, though sometimes they are articulated by tin plates, as described in respect to the fingers; a wire should be passed transversely through the anterior extremities of these bones to connect them to each other, and preserve them steadily in their relative situation.

The bones of the toes may be connected to the metatarsals, and to each other, by a wire passed through the under part of the thick anterior extremity of the metatarsal bones, longitudinally, and through the centre of the bones of the toes, securing them by a small clinch of the wire at each end; or they may be articulated by tin plates in the same manner as the bones of the fingers.

Through the whole of this Article tin plates are mentioned for the articulation of those joints, where flexion and extension only are performed to any considerable extent, merely because it has been usually employed for that purpose, but there are some exceptions to its use; in the first place, it has a roughness of surface, which prevents the bones moving upon it with smoothness and facility; it is also liable to acquire a rust from the iron plate, upon which the tin is only a thin covering; this renders the movement of the bones still more harsh: from these considerations, I would recommend brass plates in preference to tin, and these should vary in their thickness according to the size and strength of the joints in which they are employed; as it would, for instance, be inconvenient to use thick plates in articulating the small bones of the fingers, as a thicker saw would consequently be required, and thereby the bones weakened; and in the elbow or knee joint. where forcible movements may be applied, from the length and size of the bones, thin plates would be liable to accidents by bending or breaking. Brass wires are also to be preferred to iron, from their not being so liable to rust.

MODELLING.

ARTICLE LV.

Of the requisite Properties, &c. of Plaster of Paris for Modelling.

PLASTER of Paris, or Calcined Alabaster, is sold in the shops of this city, of very different qualities and prices, generally in bags, containing fourteen pounds each, at ninepence, one shilling, one and sixpence, and two shillings a bag, according to its quality; that of a middling price is used for making of moulds; the finer sort is for casts, to be poured first into the mould, when properly prepared; after it has formed a layer of about half an inch, more or less, according to circumstances, then the coarser sort is to be used to fill up the mould, or to give it sufficient thickness. Plaster of Paris is a very perishable article, and should be had of proper age from the manufacturers as it may be wanted. The peculiar quality, which renders it so convenient for the purposes of receiving the impression of both hard and soft bodies, is this, that when mixed with water (it being in the form of powder) to the consistence of cream, it absorbs the water in a few minutes, and becomes a firm solid mass, without diminishing its bulk, and consequently without cracking. If the plaster is of a good quality, it should, in about sev n or ten minutes after mixing, become a considerably harder and stronger body than chalk, and of a perfectly clear white: when the quality is not good, it is much longer in consolidating, and will not acquire a proper degree of hardness; and for a long time it will retain a soft pasty feel; and when the mass has become perfectly dry by the evaporation of the superfluous water, it is very easily crumbled to pieces between the finger and thumb: this is acquired by its imbibing the moisture from the atmosphere, so that it should always, when it is kept for any considerable time, be put in some very dry situation, where it may have constant warmth from the fire, and in such a place it may keep good five or six months.

Plaster of Paris may be coloured, by adding to it colouring ingredients of almost any kind in the form of powder, which should be intimately mixed in a marble mortar, before the water is put to it.

This circumstance should be attended to, in mixing the plaster for moulding or casting, that if it is at first made too thick, and begins to set* too soon, and more water be added to thin or dilute it, it will always prove a bad brittle composition; so that care should always be taken not to add too much plaster to the water at first.

The strength and hardness of the composition may be increased by the addition of a small quantity of common size.

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* A term used in the art to imply its hardening.

ARTICLE LVI.

General Observations on making Models in Plaster of Paris.

THE art of modelling is both pleasing and useful, and may be employed to a great variety of purposes, by the Anatomist, Antiquary, and Naturalist.

The advantage of using this substance in preference to others, is, that notwithstanding a slight calcination of the alabaster (of which it is made) reduces it to a pulverable state, it becomes again a tenacious and cohering body, by being moistened with water, and afterwards suffered to dry; by this means, either a concave or a convex figure, may be given to it when wet, by a proper mould or model, which it retains by the hardness it acquires when dry; and from these qualities it is suitable to the double purpose of making both moulds and models.

The particular manner of making Models, (or Casts, as they are commonly called) depends on the form of the subject to be taken; where there are only slightly elevated parts, the process is simple and easy; likewise, where there are such, as form only a right, or any greater angle with the principal surface or plan, from which they project: but where parts project in lesser angles, or form curves, inclined toward the principal surface or plan, the work is more difficult. These observations apply to moulds made upon hard inflexible bodies; but the case is very different with respect to those made upon soft and yielding substances, as are all the soft parts of an animal body, for if a mould is made by pouring the fluid plaster on such substances, it may often be freed from the mould, even where the object of the experiment projects in acute angles, from the surface upon which it is laid; but when the cast is made in such moulds, the mould must be removed cautiously by piece-meals, by reason of the cast not being flexible, as the original is to imitate.

The Moulds should be made of different degrees of strength, according to the size of the cast intended to be made in it; small subjects will not require them more than about half an inch thick; large ones will require them an inch, or if very large an inch and a half; as the large moulds, from the size of the pieces, the weight of the casts, and frequently some difficulty in removing them from the models, render them more liable to accidents; and where a considerable number of casts are intended to be made from one mould, it will require particular care that the mould be accurately and strongly made, and as equal in its thickness as may be.

ARTICLE LVII.

Making Moulds of Plaster of Paris on soft Bodies, and casting their Models.

WHEN the original to be copied by a Plaster Model is soft and pliable, it will generally render the process much more simple and easy, as is the case with the viscera of the body; for in such case, let the parts project as they may, this need not be considered in constructing the mould, for the original yields freely to pressure, and may easily be extracted from the mould, even through an aperture less than the bulk of the subject; this is particularly the case with the intestines, or any inflated part.

The first step to be taken, is to grease the surface of the original, to prevent the plaster sticking to it: this may be done with olive oil, laid on with a soft painter's brush; but if the part is naturally slippery, this will be unnecessary, as is the case with most of the internal parts of the body. Then lay the original on a smooth table, or other flat surface, previously greased, or covered with a cloth, to prevent the plaster sticking to it; then surround the original with a frame or ridge of glazier's putty, at such a distance from it as will admit the plaster to rest upon the table, on all sides of the subject, for about an inch, or so much as to give sufficient strength to the mould; then a sufficient quantity of fluid plaster is to be poured as uniformly as possible, over the whole surface, until it is every where covered to such a thickness, as to give a proper subsistence to the mould, which may vary in proportion to the size. The whole must then be suffered to remain in this condition, till the plaster has attained its hardness; when the frame is taken away, the mould may be inverted, the subject removed from it, and when the plaster is perfectly dry, let it be well seasoned.

For making the Casts in these moulds, the whole of the cavity must be first greased with a mixture of olive oil and lard, in equal parts, and then filled with fine fluid plaster, and the plain of the mould formed by its resting on the surface of the table, covered to a sufficient thickness with coarse plaster, to form a strong basis or support for the Cast, if such basis is requisite, which is particularly the case, where the parts represented are thin and membranous, and would not have sufficient strength of themselves.

The plaster being thus poured into the mould, suffer it to stand until it has acquired its greatest degree of hardness; then the mould is to be removed, the effecting of which is more or less difficult, according to the figure of the model; if the projecting parts only form right or greater angles with the plain of the base or principal surface, the mould may be removed without breaking; but if the parts project in any lesser angles, or form curved lines, inclining toward the general surface or plain, it will be more difficult, and endanger the model; for in this case the mould must be broken away in small pieces, by means of a small mallet and chissel.

Should any pieces of the mould be broken off, it may be cemented, by making the two broken surfaces perfectly wet, and applying them together with a little fresh mixed plaster interposed; and after it is hardened, the joint may be smoothed, by paring off the rough plaster which may have been pressed out in fixing the piece. If any small holes should be accidentally made by the chissel, they may be thoroughly wetted with water, and then filled up with a little fresh mixed plaster, and smoothed over with the edge of a knife. When the model is perfectly dry, it will be fit for colouring if necessary.

ARTICLE LVIII.

Making Moulds of Plaster of Paris on hard Bodies.

It has been already mentioned in the general Observations, that the mould is simple and easily made, even upon hard substances, if none of the projecting parts of the figure form acute angles with the plain upon which it is raised; in this case, the subject being greased with a mixture of olive oil and hog's lard, in equal proportions, the plaster may be poured over the whole surface at once, to a proper thickness; and when perfectly hardened, it may be removed in one entire piece, by separating it from the pattern with the fingers, or by carefully introducing the blade of a knife into the joint, between the mould and original; then the mould is to be dried in any exposed situation, or, if requisite, it may be done more expeditiously by artificial heat; and afterwards seasoned (see Article LIX.) when it will be ready for use. If the mould is not a very deep concave, the fine plaster may be poured into it, and managed similar to the making of the mould, spreading it equally thick over the whole surface. It is always to be remembered, that before the plaster is poured into the mould, its surface must be very thinly spread over with the oil and lard, by means of a small painter's brush, and this is to be repeated every time a cast is made.

When the object of experiment, or what the artists call the Pattern, is of an irregular figure, consisting of a number of projections, hollows, curves, and angles, the work is more complicated, in respect to constructing the mould, but not so much difference in making the cast.—To form the mould properly, it will be necessary to view attentively the pattern, and first consider in what way to proceed, that the mould may be composed of as few parts or pieces as possible; that is done by making every piece cover as much of the pattern as may be, without surrounding such projecting parts, or running into such hollows, as when the plaster is hardened will not admit the piece to come off (or what is technically called relieve or deliver) from the pattern without breaking, as, for example, would be the case with the head of the os femoris, if it was entirely enclosed in a body of hard plaster; for the cervix being of less diameter than the head, the aperture in the plaster situated round the cervix, would be too small for the head to deliver, so that the plaster should not exceed an exact hemisphere.

The same difficulty would occur by the plaster running into a hollow, the outer orifice of which is any where of less diameter than the internal part; so that the mould is to be constructed according to the figure of the pattern (see Plate VI. Fig. 3). So simple a figure as a common, round, or oval calculus may be moulded in three parts only, but to mould an os femoris would probably require ten or twelve pieces, and the joints formed by the junction of those several pieces, must run along the most prominent parts of the pattern: a little reflection will be sufficient to shew the necessity of following this rule invariably, when the mould is constructed of two or more parts, for their more convenient relief, and the stronger formation of the internal part; for where the inner surface projects into any hollow part of the pattern, such projecting ridge or point is the most liable to accident; and if divided by a joint running through it, each part being but half the thickness and strength it otherwise would have been, consequently will be much more liable to such accidents.

Where there is a necessity of internal pieces, for the filling up of any hollows, these are to be first made, and the outer pieces after the first has become hard.

The first thing to be observed in making a mould upon a hard and dry surface, is to have it smoothly rubbed over with the mixture of oil and lard, in equal parts; then such hollows as require internal pieces, are to be filled up with a sufficient quantity of fluid plaster, and while in a soft state fix a wire loop into it, as shewn in Plate VI. Fig. 3. The plaster should be a little raised in a pyramidal form round the wire, and when it is hard, the surface of it cut smooth with a knife, preserving two or three angular ridges from the loop to the outer edge; that it may fix more steadily in the outer piece of the mould afterwards to be made upon it; then let the outer surface be well greased, to prevent the second piece from adhering; the loop which is left projecting, is to be enclosed in a little glaziers putty, or some such substance, before the second piece is laid on; this may prevent an accident by the second piece taking hold of the loop, and preserves a hollow place for the cord.—For the formation of the second or outside piece, mix a proper quantity of plaster, proportioned to the extent of surface it is to cover, and the intended thickness of the mould; when it is just beginning to thicken, or assumes such a consistence, as not very freely to run off the surface, begin and spread it over the internal piece or pieces, and the pattern as far as possible, so as not to include more than will safely deliver; and as the plaster becomes more tenacious, add more on the pattern, until it is of sufficient thickness, keeping the edges smooth and square like the edge of a board: the plaster should be spread equally on all parts, and the best instrument for doing this, is a Painter's palate knife, or what Apothecaries call a bolus knife; but for this purpose it should be chosen not so pliable as they are generally made. When the outside piece is hardened, the edges are to be pared smooth, and nearly squared with a small pointed knife; in the edges are to be formed with the point of the knife, small conical holes, an inch or more distance from each other, according to the size of the piece (see Plate VI. Fig. 1.) These hollows receive the fluid plaster in forming the adjoining parts of the mould, and occasion points corresponding with the hollows, and are intended to preserve the edges of the different pieces steadily in their proper relative situations; the third piece is then to be formed in a manner similar to the second, greasing the edges of the former plentifully with the oil and lard, to prevent the pieces from adhering to each other, and thus the pattern is to be wholly enclosed, and afterwards an aperture cut in a suitable part of the mould for pouring in the plaster, and small holes are also to be bored through the mould, opposite to the wire loops fixed in the inside pieces, through which a cord is to be conveyed from the loop, to confine such pieces in their proper situation during the casting.

There are frequently occurring, cases in which the pattern is not to be wholly enclosed in the mould as before; for instance, the mould of a pedestal is to be left open at the bottom, where the fluid plaster is to be poured in, also the bottom of a bust where the supposed section of the body is made; likewise, when it may be designed to model part of the subject only, as a face, extremity, &c. In these cases where the mould terminates, there will be, of course, an aperture left for the pouring in of the plaster.

The mould being completely formed, the pieces are to be removed from the pattern or original, and exposed to the air to dry, or dried by artificial heat, and then seasoned according to the rules giving in Article LIX. when it will be fit for use.

EXPLANATION OF PLATE VI.

A Representation of several Moulds in Plaster of Paris, to illustrate the Method of constructing them on hard and inflexible Substances.

Fig. 1. Represents the mould of a human calculus, made in three equal parts, and is of the most simple construction that a mould can be made, to be certain of delivering the cast without difficulty, or hazard of breaking, where the pattern or original is to be completely enclosed, in order to copy every part of its surface. The several parts which compose the mould, shew also the proportionate thickness it will require, to give it proper strength.

A A A. The internal concave surfaces, which were in immediate contact with the calculus, in the formation of the mould, and receive an exact impression from its surface, whilst the plaster is in its fluid state.

B B B. Are three holes bored in one edge of the first formed piece, with the point of a knife, after the edge had been cut smooth ; these holes are filled with the fluid plaster in forming the second piece, which, when hardened, become the projecting joints, marked C C C. These points are intended, by entering the corresponding holes, to keep the edges of the mould steadily fixed to each other. In like manner the holes D D D D receive the points E E E E, as also those marked F F F receive the points G G G, for the same purpose. When the three parts are properly joined, they form a complete oval cavity. At the upper end of each portion of the mould, is a notch I I I, which when the parts are joined, form a circular aperture, expanded toward the outer surface; through this the fluid plaster is to be poured in, in order to make the cast; but before this is attempted, the several parts of the mould should be securely bound together with a cord; without which they would be liable to separate, and suffer the plaster to escape.

Fig. 2. A representation or longitudinal section of a mould of a diseased femur, to shew the manner in which the different parts are joined.

A A. The diseased femur of an irregular figure.

B B B B B B. Are the several outside pieces, which enclose the bone.

C C. Are two inside pieces to fill up those hollow parts, which would otherwise prevent the mould from coming off from the bone without breaking; they are connected to the outside pieces by the loop and string, the principle of which is better explained in Fig. 3.

D D D D D D D. The several transverse joints of the mould, so formed as to admit every piece to separate easily from the bone and model, afterwards to be cast in it. Those joints are to be made upon the most prominent parts of the original or pattern. The break or angle in the middle of each joint, represents the holes and points, to keep the several pieces of the mould steadily fixed to each other, described in Fig. 1.

E. A circular aperture where the fluid plaster is to be poured into the mould; this is always to be formed in one of the joinings; so that the projecting piece of plaster in the aperture may deliver from the mould without breaking, and should be made opposite to some plain projecting part of the original, which may be easily smoothed over with a knife, when the superfluous piece is removed from the cast.

Fig. 3. Represents an imaginary section of a mould, to illustrate the form and use of internal pieces, when the pattern or cast will not otherwise deliver.

A A A. The original or pattern.

B B B. The outer part of the mould.

C. An internal piece, which fills up a deep hollow, running in an oblique direction; on which account had it not been filled by a separate piece, would, most probably, be broken off in removing the mould, as it will only deliver in a direction corresponding to its obliquity. In the upper part of this piece is fixed a brass wire, with its points separated, and incurvated, in order to give it a securer hold; the loop projects above the surface, and is to be surrounded with Glaziers putty, to prevent the plaster taking hold of it in making the outer piece.

D D. The upper surface of the internal piece.

E E. Are two lines which describe a vacant space round the wire loop, and a hole bored through the outside piece, for the passage of the cord, which is passed through the loop, and brought to the outer surface of the mould, over a short piece of stick, and secured by a knot, F; when, by twisting the cord, the internal piece is properly secured to the external, during the act of casting the model; when the plaster is hardened, and the mould is to be removed, the cord must be relaxed by untwisting, the knot untied, and the stick removed; this will leave the outer piece at liberty to be removed with facility, and afterwards the inner piece. The loop and cord afford a convenient hold to withdraw the piece.

G, H, I. Are three internal pieces, which are sometimes necessary to be formed in this way, when the cavity to be filled extends in two opposite directions, or is of greater diameter within them at its entrance; the two pieces, G and H, have the wire loop before described; the cords fixed to these pass through two holes in the middle piece I, obliquely, toward the centre of its upper surface, where they meet, and are conveyed together to the outside of the mould, and fastened with a stick as before described. The piece marked I, answers as a key-piece to the other two, which being first removed (after the external part) gives room for the other two to be drawn out.

KKKKKK. Are very small holes and points, to keep the several pieces steadily fixed in the proper situations, as described in Fig. 1.

Fig. 3.

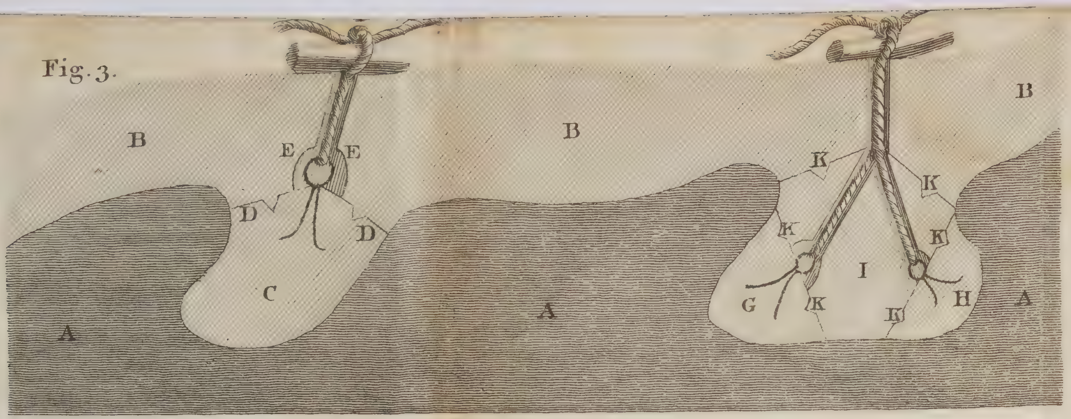


Fig. 2.

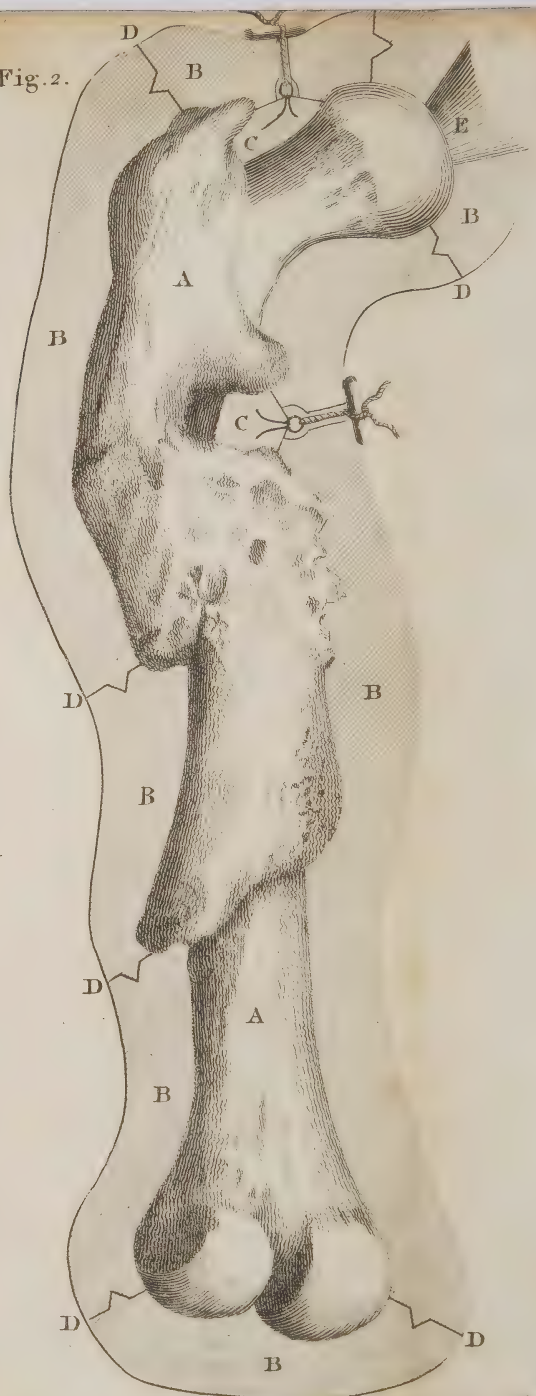
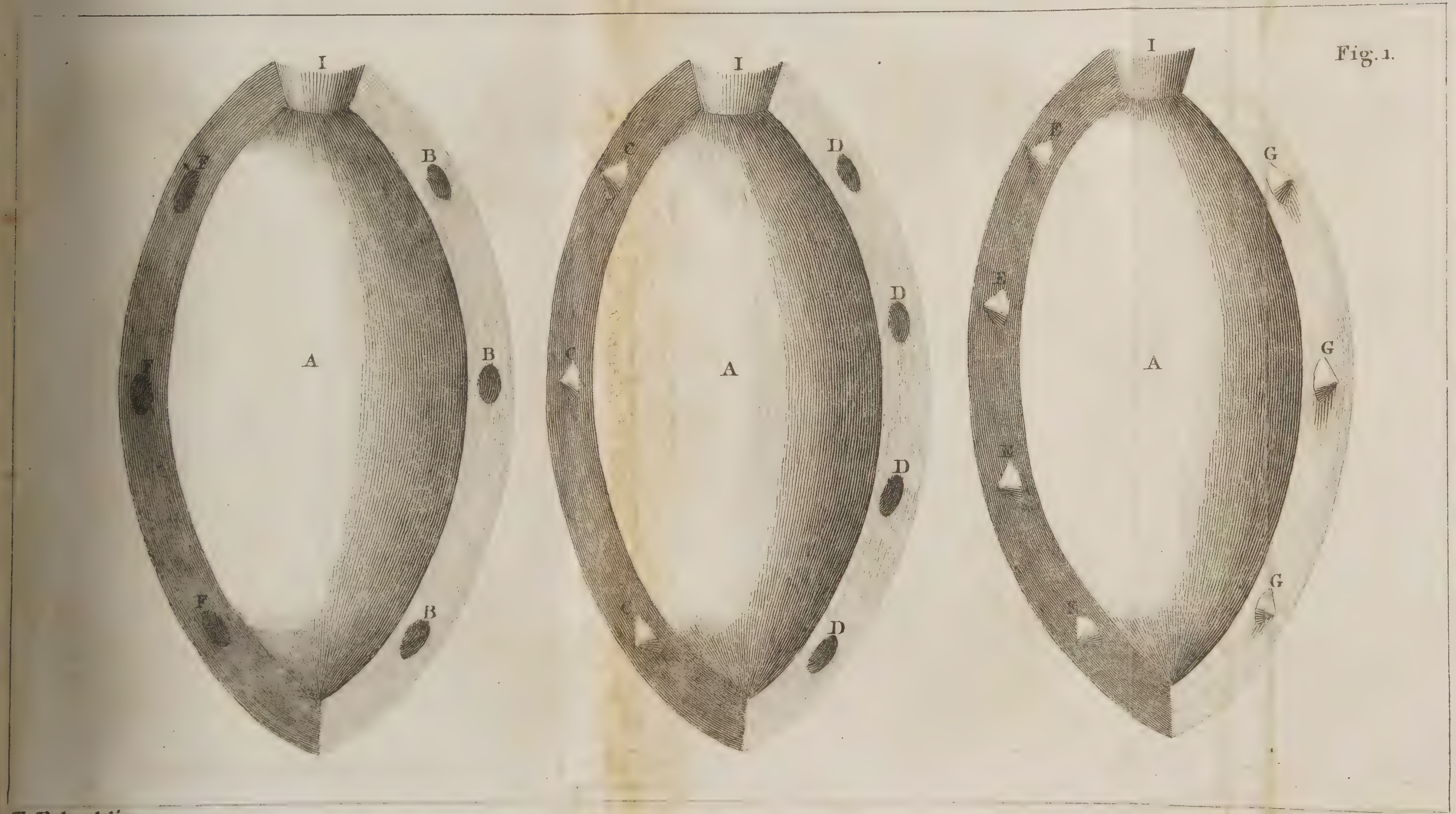


Fig. 1.



T. Pole delin:

G. Barrett ſculp.

ARTICLE LIX.

Seasoning of Plaster of Paris Moulds.

By seasoning of moulds, is meant the preparing them for use after their first formation. The first part of this process is to make them perfectly dry, which, if the mould is of considerable thickness, will require two or three weeks, unless it is expedited by artificial heat; when dry, they are to be brushed over plentifully with boiled linseed oil, made more drying by the addition of finely levigated litharge, white vitriol, or sugar of lead. The inside and the joints of the mould should be particularly well supplied with it; if it be large, the outside need not be attended to, as it would be an unnecessary waste; very small moulds are sometimes boiled in the oil, which fills the pores more perfectly, and gives a greater hardness to the plaster. After the mould is sufficiently oiled, it is to be set aside until perfectly dried; when, if the surface and joints are thinly brushed over with the olive oil and lard, they will be fit for use.

If linseed oil be used instead of lard, to grease the mould, in order for casting, it will occasion the cast in a short time to assume a disagreeable yellow colour.

ARTICLE LX.

Of casting with Plaster of Paris.

CASTING with Plaster of Paris in moulds made of one entire piece, where the projecting parts form obtuse angles with the general plane, is very simple and easy: nothing more is necessary than to thinly grease the inner surface with the oil and lard before mentioned, by means of a painter's brush; and then pour into it first a small quantity of plaster, mixed to proper consistence, to flow into all the minute parts, which may be assisted by shaking the mould; then add more, so as to cover the whole inner surface; and as the plaster begins to acquire a degree of firmness, it may be disposed in any manner we wish, when it should be raised to a proper and equal thickness on the mould, by means of a bolus knife; the edges should be kept square and even, whilst the plaster is sufficiently fluid; but this should always be done as expeditiously as possible, carefully avoiding any disturbance to the stratum of plaster in conjunction with the mould. If we continue working the plaster with the knife for an unnecessary length of time, whilst it is hardening or setting, it will greatly dimish its cohesion, and render the model brittle. When the model has acquired a sufficient hardness, it may be removed from the mould by a careful separation; but where the mould is such as will not admit the delivery of the model, it is to be removed by piece-meals, with a small hammer and chisel: this will require great caution not to break the body of the model, or chip out pieces from the surface; if small pieces should be thus accidently broken off, it may be afterwards repaired by thoroughly wetting the parts, and then filling them with a little fresh mixed plaster.

For casting in moulds of a more complete cavity and complicated construction, it will require a different process; the several parts of which the mould is composed, having their internal surfaces and edges greased with the oil and lard as before, are to be properly put together, and bound by a cord round the mould, in such a manner as to secure them in that situation, and prevent the fluid plaster escaping through the several joints: some fine plaster is then to be poured in at the open end or aperture, and the mould turned about in all directions, so as to give the plaster repeated opportunities of spreading itself over the internal surface: when this is sufficiently hardened, pour in more fresh mixed plaster, and turn the mould about as before, so as to spread it over the whole of the plaster first introduced, and then the thickness of the cast (varying according to its size) may be made up by a repetition of the same process, with the cheaper kind of plaster; this will give a fine surface to the cast, which will look and answer as well as if the whole was composed of the same materials. If the model is to be made solid, it may be filled with the coarse plaster after the mould is sufficiently lined with the fine as above. When the cast is hardened, the cord may be taken off, and the pieces of the mould carefully removed. To finish the model, nothing more is necessary than to smooth off the seams, and mend any little imperfection in the surface, by the means mentioned in Article LXIV.

Where internal pieces are required in the mould, they are to be securely fixed to the external, as already described, before the several outer parts are put together for casting; and the cords, after casting, are always to be loosened by removing the twisting sticks, and untying the knots, otherwise the cast or mould will be broken in their separation.

Such subjects as will not admit of being cast entire (as a human figure with its extremities extended) are to be cast in detached parts, and joined afterwards: the legs and arms may be strengthened, by introducing a stick into the centre of the mould, whilst the plaster is in a fluid state; but this is only done when the cast is made solid, that is, no cavity left in its centre. In very small slender parts a brass wire may be used instead of wood; iron wire is apt to rust and give a stain to the model.

ARTICLE LXI.

Of moulding and casting Busts from living Subjects.

THIS is an operation which should be conducted with considerable caution, otherwise the person subjected to it may be suffocated. This branch of the art of modelling, will frequently be found very useful to those who wish to enrich their anatomical cabinets with rare and extraordinary cases of disease, producing considerable alterations in the external figure of the parts.

For the purpose of making the mould, the person should be laid horizontally on the back, with the head raised by a pillow to that exact position (relative to the body) in which it is naturally carried when the body is erect; then the parts to be represented, are to be very thinly covered with fine oil of almonds, by means of a soft painter's brush; the face is then first to be covered with fine fluid plaster,* beginning at the upper part of the forehead, and spreading it over the eyes, which are to be kept close, that the plaster may not come in contact with the globe, yet not closed so forcibly as to cause wrinkles unnatural to the part; then cover the nose and ears, first plugging up the meatus auditorii with cotton, and the nostrils by a small quantity of tow rolled up, of a proper size, to exclude the plaster from those cavities; during the time the nose is thus stopped, the person is to breathe through the mouth; in this state the fluid plaster is to be brought down so low as to cover the upper lip, observing to leave the rolls of tow projecting out of the plaster; the process being carried thus far, the plaster must be suffered to harden, when the tow may be withdrawn, which will leave the nostrils open and free to breathe through; then the mouth is to be closed in a natural and easy position, and the plaster advanced to the extremity of the chin: afterwards begin to cover that part of the breast to be represented, and spread the plaster to the outsides of the arms, and upward, so as to meet and join that which is previously laid on the face; when the whole of the mass has acquired its due hardness, it is to be cautiously lifted off, so as not to break in any part, or give pain to the person; which may easily be prevented by a little deliberation and care.

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* The plaster for moulding from a living subject will be less disagreeable, if mixed with warm, rather than cold water.

The mould being thus constructed, let it be dried and seasoned, the cast or model is then to be made by pouring fluid plaster over its concave or inner surface, and distributing it equally on all parts; but the holes in the mould, occasioned by the tow placed in the nostrils, should be first stopped by a little plaster placed externally after the cast is thus formed, of sufficient thickness in the mould, the latter is to be removed by carefully breaking it into small pieces with a mallet and chisel. The eyes, which are necessarily shown closed, are to be carved, so as to represent the lids elevated, which is performed without difficulty; the nostrils are also to be hollowed out with the point of a knife; the back part of the head, which is not represented, on account of the difficulty of moulding parts covered with hair, being always disposed to adhere to the mould, is to be afterwards formed by plaster from the fancy or ingenuity of the artist: the edges of the model are to be neatly smoothed off, and then the bust fixed on a proper pedestal.

Some artists, who are in the frequent practice of taking masks* and busts, use metallic tubes to place in the nostrils instead of the tow; but I have repeatedly used tow without any inconvenience: which ever is used, they should be introduced so as not to distort the part where an exact representation of the expression of the countenance is required.

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* So called when the face only is cast.

This operation, though it may strike an inexperienced person with disgust, is performed without much inconvenience to the person subjected to it, and what personages of high rank submit to, as the means of preserving the most accurate and infallible likenesses.

ARTICLE LXII.

A Method of representing the Out-lines of any Figure in Plaster of Paris.

FIRST draw with a black-lead pencil the subject to be represented; then take a quire of paper, and lay upon it a smooth piece of tin foil, large enough to include the sketch made with the pencil; lay the drawing on the foil, and with a blunt-pointed instrument, as large as a needle, fixed in a proper handle, trace the drawing over, bearing the point upon it sufficiently hard to make a deep impression in the foil, which afterwards is to be very lightly rubbed over with olive oil, by means of a fine camel's-hair pencil; then mix a sufficient quantity of plaster of Paris, and pour over it to a proper thickness: when it has acquired a proper hardness, raise it from the foil, and there will appear in a raised line a copy of the drawing.

By a little care not to injure the foil, it will serve for a considerable number of copies. It must be remembered, that if the drawing is traced upon that side of the paper on which it is made, the plaster impression will show it reversed; so that to represent it according to the original, it should be traced on the reverse side of the paper, and for which reason oiled paper is preferable, as in that the drawing may be seen on the contrary side. This mode of taking impressions from foil, is simple, easy, and expeditious, where a considerable number of copies is wanted; and it seems probable, that with some little improvement, it may become much more useful; if a method can be acquired to impress deep concaves upon it, in such a manner as to retain the impressions, it may be employed in making slightly raised figures in the manner of basso-relievos: this may be assisted by spreading the foil on a smooth even bed of Glaziers putty, half an inch in thickness; the surface may be made an exact plain, by pressing the foil upon it with a smooth piece of board; the putty, if not made too soft, will receive and retain the impression made by pressure on the foil with proper instruments, much better than if the foil lay on a hard table.

ARTICLE LXIII.

Of making Moulds in Wax on irregular Bodies, and casting in Plaster of Paris, without Seams.

THIS is a mode of making Casts, which I believe has never been practised by any other person, though it is attended with very little difficulty; nor is that difficulty increased by the greater irregularity of bodies upon which the mould is made; but it must be remembered, that only such bodies can be modelled in this way as may be readily destroyed by acids, therefore any fleshy or bony substances are favourable for the purpose. The mould is to be made of a composition of wax, rosin and turpentine varnish; which ingredients are to be used in the same proportions as for coarse injection, only omitting the colouring matter, not as hurtful, but unnecessary. The preparation to be modelled should be placed upon a smooth board (made sufficiently wet to prevent the wax from sticking to it) in that exact position in which it should be represented; then gradually pour on the composition, liquified by heat, and as it cools on the surface, add more from time to time, until every part is covered to a sufficient thickness, to bear handling without bending, which would deform the mould, and consequently the model: it should be made at least a quarter of an inch thick upon every part; when the wax is perfectly cold, let it be carefully removed from the board, and in its lower part an opening will be left, by a part of the original being in contact with the table or board, through which the whole or a part of the preparation may be withdrawn, without injuring the mould. If it can by any means be wholly withdrawn, there is no occasion for corrosion; but if it cannot, it must be laid in the diluted muriatic acid to corrode it so perfectly, that it may be washed away with a stream of water. The acid is to be prepared in the same manner as directed for corroding injected preparations. The preparation being entirely dissolved, and washed away, suffer the wax mould to get perfectly dry, then fill the cavity with plaster of Paris; when this is hardened, put it into a proper vessel of water, and set it over the fire, in order that the wax may liquify and rise to the surface, which when cold may be removed, and the plaster model taken out; the water does not break down the texture of the plaster. The model will not be of a good white, on account of the wax entering the pores on the surface, and communicating its colour; but this is a circumstance of no consequence, when it is to be painted after nature: if it should be wished to preserve the model of a better white, white wax, without any mixture, should be used.

To make a mould of some preparations, it may be necessary to immerse them in a vessel of melted wax until it is cold; but care should be taken that no part touches the bottom or sides of the vessel, or floats to the surface; as this, however small the points of contact, would form openings in the mould in improper places: when the wax is cold, remove the mass from the vessel in its entire form, and make an opening with the knife in the mould, opposite to that part of the preparation, which is of least consequence if disfigured; this opening is to give the acid access to the preparation, which is then to be corroded, and the process conducted as before described.

ARTICLE LXIV.

Of making Moulds with Putty, and casting with Plaster of Paris.

PUTTY * is not adapted to the making of moulds, to afford so accurate an imitation of the original as plaster of Paris, but may sometimes be used for subjects whose figure will not admit of being moulded in plaster, as is the case where there are numerous projecting points, incapable of delivering from a more solid mould, as is sometimes the case with diseased bones. One surface only, consisting of not more than an hemisphere or semi-cylinder, can be represented in one cast; so that to exhibit the whole surface of a bone it will require at least two casts.

The manner of conducting this process, is first to prepare a bed of putty upon a table, of such size and shape as the original may require; it should be squared at the sides, and its upper surface made smooth and even; then the original is to be thoroughly wetted and placed upon the putty, with that side downward intended to be represented; in that direction it must be pressed into it, so as to include half its circumference, and the edges of the putty round the original should be pressed close to it; then let it be carefully removed, preserving the flatness of its upper surface by the assistance of a bolus knife. Upon the flat surface of the putty, make a rim at a sufficient distance from the impression, when it may be filled with fluid plaster until it flows over the upper smooth surface to a proper thickness; that on the surface of the putty will afford a base to the model of a sufficient strength, if such base is needful, which may not always be the case. When the plaster is sufficiently hardened, remove the putty from the cast, pick out such pieces as may be left in the interstices, then cut the edges of the base square and even. A repetition of the same kind of process with the other side or sides of the original, will give a good representation of the subject. Thus I have frequently taken moulds of bones, shells, fossils, &c. None but such things as are tolerably hard and inflexible, can be imitated in this way, on account of the force necessary to be made to impress them in the putty, which, if they are yielding, will disfigure their several parts.

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* The Putty here meant is that kind used by the Glaziers; but with raw instead of boiled linseed oil.—It should be kept under water when not used, to preserve it from drying.

ARTICLE LXV.

Of smoothing the Surface of Plaster Models.

THIS is done by means of fish skin and Dutch rushes, such as are used by Cabinet-Makers. When a cast is taken from a mould, constructed of several parts or pieces, there will be small projecting lines formed by the plaster running a small distance into the joints of the mould: these projecting lines, called seams, are to be carefully removed with a small knife bent laterally, so that the point may not cut the surrounding parts; afterwards they may be more neatly smoothed by a Dutch rush.

The fish-skin is used to take off any more considerable roughness which may arise from a bad mould, or otherwise; but as it leaves a scratched rough surface, it should be finished by the rushes.

It frequently happens that there is a considerable number of air holes in the surface of a model, owing to small bubbles being retained under the plaster, when poured into the mould, especially if the plaster should be too thick; they are to be filled up with a little fluid plaster with the point of a knife; but the holes should be thoroughly wetted, by means of a sponge dipped in clean water, immediately previous to the application of the plaster. These parts are afterwards to be smoothed over as before described.

ARTICLE LXVI.

Of colouring Models in Plaster of Paris.

THERE are several kinds of colouring used upon plaster of Paris, but I do not know any better for anatomical models, than the common oil paint used by Sign and House Painters; for this has one considerable advantage, in not being injured by washing with warm soap-water and a soft Painter's brush: it should be done at least two or three times over where the cast is designed to shew any thing which has a natural gloss, as any internal part from its moisture, the globe of the eye, &c. When models of this kind are raised upon a plaster ground or base, they may, if necessary, have a gloss, and the ground be painted of a dead colour; this distinction may be made by painting the model twice over, and the ground but once; or if it is not necessary to paint the model twice, it may be varnished when dry, with oil varnish. Where the oil colouring is used, any little injury in the cast or model may be repaired with Glaziers putty, which would not answer if water colours were used.

With respect to the art of imitating nature by colours, this can only be acquired by practice and the exercise of genius; it is an art distinct from anatomy, yet is very necessary for an anatomist to be acquainted with; and was it more regarded as a necessary part of education in youth, designed for this study, we should not have had so many badly executed anatomical plates published by eminent authors; and by this means too, many important cases might have been communicated to the world, which for want of it are buried in oblivion.

ARTICLE LXVII.

Of repairing injured Casts in Plaster of Paris.

CASTS in Plaster of Paris are very liable to accidental injuries; and without some knowledge of this kind, many valuable cases may be wholly lost.

When the casts have never been oiled or painted, the pieces accidently broken off may be replaced, by first thoroughly wetting the two parts which are to be joined, then spreading on each a little fluid plaster, and applying the surfaces, pressing them close upon each other, and wiping off the superfluous plaster, which may be pressed out of the joints: if any pieces should be lost, the space may be filled up with fresh mixed plaster; and when hardened, shaped with a knife, to imitate the original figure of the part, and afterwards smoothed with a Dutch rush, if necessary. When casts have been oiled or painted with oil colours, they are not so favourable for repairing in this way, except when a fracture happens through a part of considerable thickness; for that which has once imbibed the oil, is unfavourable for the adhesion of fresh mixed plaster; those not disposed, on this account, to adhere firmly, may be fixed by means of strong glue;

and if such pieces, not very large, should be lost, the part may be supplied with bees-wax, rendered more pliable by the addition of a small quantity of common turpentine: this may be used in such a degree of heat, as will facilitate the formation of it according to the original figure of the part; should it get cold and hard during the application, it may be easily softened by holding near to it a hot iron of considerable thickness. Glaziers putty may be used for the filling up of any very small chasms; the part being lightly brushed over with boiled linseed oil, before the putty is laid on, that it may strike the better; when the part is neatly painted, it will be quite unobservable. If putty is used to fill any considerable vacuities, it will shrink in the process of drying, and give an uneven, unnatural surface; for which reason wax is recommended in such cases.

APPENDIX.

ARTICLE I.

Of preserving Preparations in Spirits of Wine and Oil of Turpentine.

PREPARATIONS of almost every part are occasionally kept in spirits, unless their size renders it impracticable, more especially diseased parts; as by this mode they undergo less change of appearance than by any other method of preservation, and consequently give the best idea of the natural or diseased appearance; but the expensiveness of the glass and spirits is a great inducement to the making of so many dry preparations.

All parts intended for preservation, previous to their being put into spirits, should be macerated in water to extract the bloody colour; and the water changed from day to day, as long as the part will bear it without putrefaction, or until it becomes quite colourless; and should be freed by dissection, from all surrounding unnecessary cellular membrane, adeps, &c. which may obscure what is intended to be shewn. It should be then suspended in spirits, in a position the most favourable for exhibiting its principal parts: if it should be an hollow preparation, as a bladder, hydatid, intestine, &c. or if it should have any hollow parts, cavities, or sinuses, necessary to be shewn, such should be distended with curled hair, wool, cotton, or the like; small blood-vessels, ducts, &c. are sometimes shewn by the introduction of bristles, quills, or bougies. In this way, the several parts being put into their natural position, and suspended in spirits for a week or ten days, according to the bulk of the preparation, they become much harder and firmer in their texture; so that they will retain their position, when the hair, wool, cotton, bougies, &c. are removed, to shew the hollow parts which have been distended by them. The preparation should then be put into a glass of a proper size and figure, and filled with spirits finely filtered, and enclosed according to the directions given in the following Article.

It will not be always necessary to have the spirits of the same degree of strength, this will depend upon what kind of preparation it is intended for; all those that are thick and massy, should be put into pure rectified spirits; such as are not so, will not require more than one half spirits, and the other water; and such as are very thin, as membranes, only one part of spirits and two of water. The spirits and water should always be mixed some days before it is wanted, and finely filtered from the sediment, which the mixture will generally occasion.

Great care should always be taken that the preparations are not dirtied in the dissection, which may be avoided by dissecting them on a clean cloth, and with clean hands; this circumstance ought to be particularly attended to in wet preparations, as it will be most visible on such, from the whiteness occasioned by the maceration and the spirits.

Immersing preparations in oil of turpentine, is not so much for their preservation, as to render them transparent, for the purpose of shewing some organization, as blood-vessels, lymphatics, lacteals, excretory ducts, &c. and is only suited to such as are dried.

The oil of turpentine used for this purpose should be perfectly colourless and transparent, and great care taken to secure it in the vessel; for it will be found difficult to prevent its escaping and trickling down the outside of the glass, which gives it a disagreeable stickiness.

What peculiar preparations should be kept in oil of turpentine, have been mentioned in their respective articles, where particular directions are given for the making of such: the foregoing hints of the general intention in the use of this fluid will be sufficient for the present place.

ARTICLE II.

Of enclosing Wet Preparations.

IT is found to be attended with no small difficulty, to enclose wet preparations in glasses, so as to prevent effectually the evaporation of the spirits, which occasions very considerable trouble, and no small expense to keep a large anatomical collection in good order. The method now commonly used is to suspend them by a thread, which is brought over the rim of the glass, and fastened to another, round the neck; but the thread so placed acts as a capillary siphon, and leads the spirits out of the glass to the neck, where it has an op[illegible]nity of evaporating, and therefore is improper. [illegible]er method is to suspend them by means of a g[illegible] (as described in Plate VII. Fig. 6.) instead of a [illegible]k float, used by some Anatomists, which is apt to colour the spirits. When the mouth of the glass is small enough, a cork may be fitted to it, and the suspending thread carried through it, and secured on the top; but such a cork should be chosen as will not be likely to colour the spirits, and should not stand above the brim. Some place a piece of stick across the mouth of the glass, and fasten the suspending thread to that; either of which may be used according to our convenience or choice: oil has been sometimes used to cover the surface of the spirits, in order to prevent its evaporation; but this will also sometimes stain the spirits, or render it turbid, by being agitated together from time to time. The floating globe, where the preparation is not too heavy, is undoubtedly the best method, as by it those several inconveniences are avoided. The preparation being then properly suspended, the edge of the glass is to be covered with mucilage of gum arabic, a wet bladder drawn smooth and tight over it, and bound down by fine packthread, wound six or eight times round the neck of the glass; this being suffered to dry, is to be lightly rubbed over with mucilage, and covered with a fine piece of tin foil, cut so as to extend but just over the edge of the glass, and rubbed down to it as close as possible; over this a second bladder is drawn tight as before, and carefully bound down by as many regular turns of packthread as will extend from the rim to the bulge of the glass; this second bladder should smoothly cover the bulge of the glass, and be confined in that situation by a cord, binding it below until it is dry, when the edges may be cut smooth as shewn in Plate III. Sometimes the tin foil is put on first, and the bladder is over it;* and I think that much the best method. Care should be taken that there are no holes in the foil or bladders.

There is a mode of securing the spirits, which I have found from many years experience, more effectual than those in present general use, which is to cover the edge or rim of the glass, with fine soft Glaziers putty; then cover the mouth completely with a piece of flat common window glass, cut to the exact circumference of the rim of the vessel it is designed to cover; the putty should be laid on with great smoothness, so as to guard against any air-holes; the surfaces of the glass to come in contact with the putty, should be previously rubbed with a little boiled linseed oil, the glass cover should be then carefully applied; over this may be stretched a bladder or two, and bound as before described, covering the bulge of the vessel: when perfectly dry, the edge of the bladder round the bulge, should be cut even with a knife, and the bladder covered with a black varnish,* to make it more secure, defend it from wet, and give it a neater appearance; or the glass vessels may be made with covers, fitted on with putty.

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* We cannot in this way prevent the spirits from evaporation, so well as by putting on a bladder first, as the bladder sticks firmly to the glass, which the lead does not.

EXPLANATION OF PLATE VII.

The Representation of several Sorts of Glass Vessels for enclosing Wet Preparations, either of Spirits of Wine, or Oil of Turpentine.

Fig. 1. A tall cylindrical vessel, adapted to long slender preparations, such as bones, portions of intestine, nerves, specimens of worms, &c. This vessel, on account of its height, should have its bottom considerably expanded, to give it a safer standing, as represented in the plate.

Fig. 2. A vessel for containing preparations of a flexible kind; for the narrowness of the mouth requires that they should be compressed into a much smaller diameter, in order to get them into the vessel,

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* Black varnish is made by mixing as much lamp black with the copal, or oil varnish, as will make it opaque.

Plate VII

Fig. 1

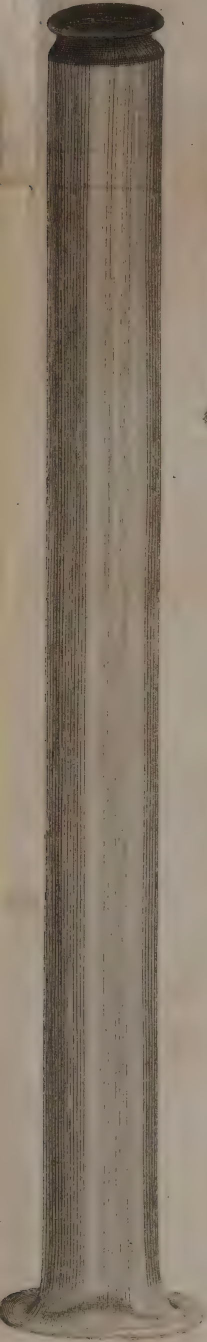


Fig. 2

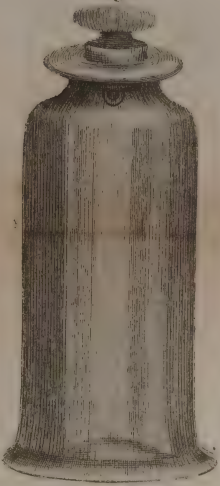


Fig. 3

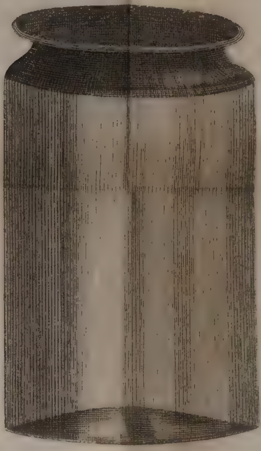


Fig. 5

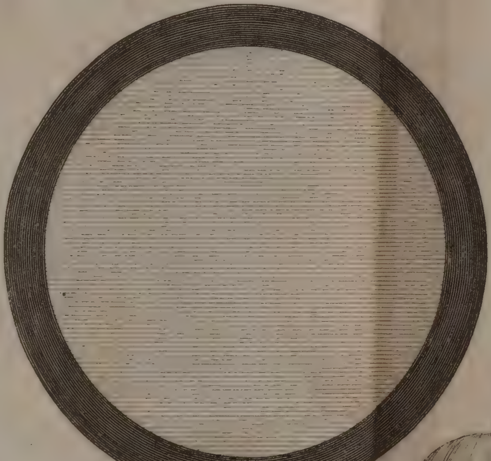


Fig. 6

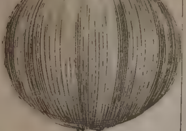
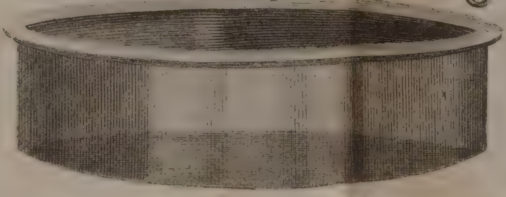


Fig. 4



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which will expand themselves when suspended in the spirits. This has a ground glass stopper, a method of closing preferable to any other, for retaining such evaporable fluids as spirits of wine. At the bottom of the stopper is a glass loop, from which the preparations are to be suspended, to avoid the necessity of glass floats, or a thread being brought through the mouth to the external air, which always greatly promotes the evaporation of the spirits. The bottom of this vessel is also expanded to give it a better standing, but not so much in proportion to its diameter as Fig. 1.

Fig. 3. A glass jar or vessel for containing the more bulky and solid preparations; the mouth is made wide to receive such as cannot be compressed into a small diameter.

Fig. 4. A glass bason for broad and flat preparations, as placentæ, female breasts, &c. These should be made about three inches deep, and about twelve or thirteen in diameter; the rim of which is to be turned outward, and flattened horizontally, about three eights of an inch in breadth. In making these and all other vessels for such purpose, care should be taken that the centre of the bottom is rather hollowed upward, for if they rest the least upon that part, it will give them a perpetual disposition to move about at the slightest touch, and always render them liable to accidents.

Fig. 5. A flat circular piece of glass, of the same diameter as the rim of the bason, with which the latter is to be covered in the following way. First, oil the rim on its upper surface, very thinly with boiled linseed oil, as also the margin of the glass cover, as far only as will come in contact with the rim; then lay a line of soft Glaziers putty on the rim as smooth as possible, of sufficient thickness to fill the interstices between that and the glass cover; then lay on the cover, and press it down carefully until there is no vacancy left betweén it and the bason for the evaporation of the spirits, smooth off the putty from the edge, and set it aside for a few weeks, to give the putty an opportunity of drying; after which, a margin of black varnish may be laid on of sufficient breadth to conceal the putty, as shewn in the plate. In this kind of vessel we view the perparation perpendicularly. It should be remembered, that putty ought not to be used if the vessel contains oil of turpentine, for that being easily miscible with the turpentine, will soon incorporate with it, and render the whole muddy and opaque; it is attended with no small difficulty to secure oil of turpentine in vessels covered with glass, and should always be avoided, if possible; it should be secured by the old method, by stretching over the mouths of the vessels bladders and tin foil, as has been already described, which, when dry, may be cut so as to leave a margin, and afterwards black varnished.

Fig. 6. A glass float, which is intended to float upon the surface of the spirits, or oil of turpentine, in which preparations are placed, to suspend them in the fluid, and avóid the necessity of a thread being brought over the rim of the vessel. This float is a glass globe, blown very thin, with a small loop in the bottom, from which the preparation is to be suspended; these are only adapted to such parts as are of no very considerable weight; one, two, or more of these may be used in the same vessel, as occasion may require. The floats should not be made so spherical as represented in the plate, but more flattened on the side opposite to the loop, by which they will occupy less perpendicular space.

ARTICLE III.

General Observations on drying Preparations.

PARTS of the body designed for dry preparations, should always be finished with expedition, that their natural colour may be as little as possible altered by putrefaction, unless it is a necessary part of the process, which is sometimes the case: great care should also be taken that they are not dirtied in the preparing, especially if they are fine transparent membranes, as it will greatly diminish their beauty when finished. The adeps should every where be removed, otherwise it will give a greasiness to the surface very unfavourable for the drying of the varnish: but to remedy this inconvenience more effectually, when the preparation is dry, it should be washed over with soap-lees, and suffered to dry a second time: this may be repeated two or three times, if occasion requires; but if they are not of considerable substance, such washing will be generally very inconvenient; and as this is one of the most unpleasant circumstances in dry preparations, we ought always to make choice, if possible, of such parts as have little or no fat about them, unless it can be easily and entirely removed.

Anatomical preparations should always be dried in the shade, where there is a thorough draught of air: on some occasions, as in very damp warm weather, when they may be in danger of spoiling from putrefaction, they had better be dried by artificial heat, and may be placed at a considerable distance from a fire, especially if they are injected with the coarse or fine injection, otherwise it will be so softened by the heat, as to escape from the vessels at every small orifice: if they are hollow, as bladders, intestines, &c. distended with air and confined in them by ligature, or otherwise its rarefaction may burst and destroy them. Membranes and other thin parts which are to be dried flat, may be stretched out upon a soft deal board with pins, having interposed between them and the board a piece of oiled paper, not so much oiled, as to leave any greasiness on the preparations, but merely to prevent their sticking fast to the board.

Dry preparations in general require considerable care to preserve them from insects,* dust, accidents, and the officious hands of those unacquainted with their value, and the trouble of making them:—for this reason they should be enclosed in vessels, or cased, according to their size or figure.†

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* See the Article on that subject.

† See Plate VIII.

Plate VIII

Fig. 1

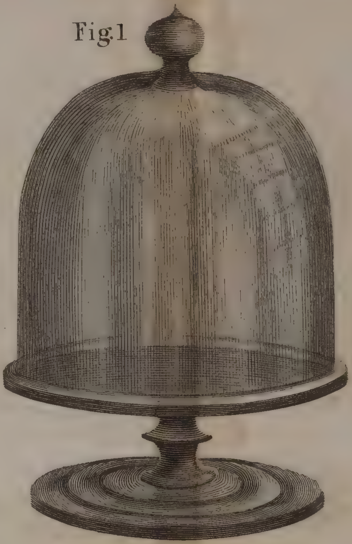


Fig. 2

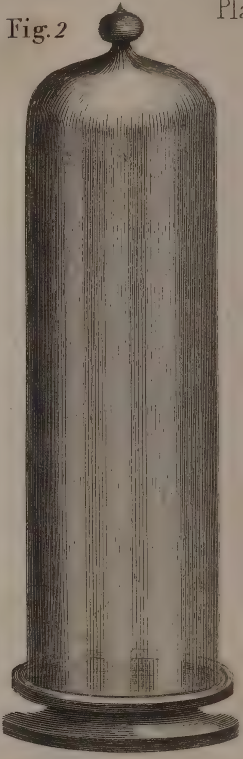


Fig. 3

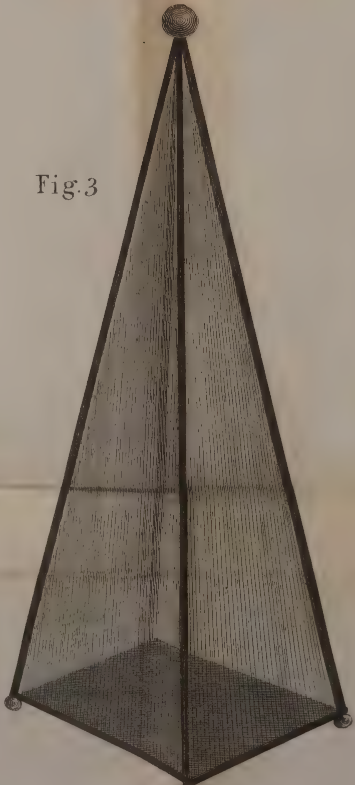
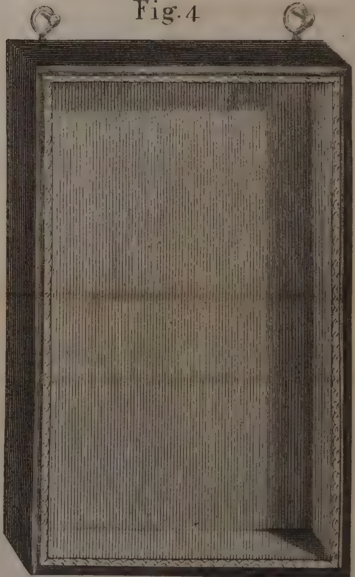


Fig. 4



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W. Darton & C° f

EXPLANATION OF PLATE VIII.

Representing several Cases, Pedestals, and Covers, for enclosing dry Preparations.

Fig. 1. A pedestal and glass cover for preserving corroded or other preparations approaching to the spherical figure, as corroded livers, lungs, kidneys, spleens, &c. or others not corroded, as hearts, heads, stomachs, bladders, portions of inflated intestines, &c. —Corroded preparations, and sometimes others, should be fixed on pedestals* of Plaster of Paris, and cemented by glue, or mucilage of gum arabic, on the centre of the wooden pedestals here described.

Fig. 2. A pedestal and glass cover intended for preparations approaching to the cylindrical figure, as single bones, fœtal skeletons, blood-vessels, extremities, &c.

Both these pedestals are usually made of mahogany; the cover of the first being short, is elevated upon a stem: the latter having so lofty a cover is made much flatter, that it may have a safer standing, and rendered less liable to accidents, and should be turned out of one piece of wood: the deep groove between its top and bottom, is for the convenience of lifting it; the covers are always to be made of the finest white flint glass.—These two patterns exhibit the greatest contrast; but they may be made in any intermediate degree of height or diameter, to suit the purpose of the

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* See Plate IX.

Anatomist, or the preparations they are designed to contain.

Fig. 3. A pyramidal case. The frame of this case may be made of wood, or of metallic substance, in the manner of the common glass lantern, including four triangular pieces of glass; the bottom should be made of wood of a considerable thickness, as it is sometimes necessary to carry a wire through it to fix a preparation on; and the thickness of the bottom is useful to preserve it steady, especially if the preparation should be of considerable weight. The ball represented on the top of this case is for the convenience of lifting it. This is principally to contain diseased cylindrical bones; one extremity of which is often enlarged by exostosis, and is to be placed at the bottom of the case, and its small extremity toward its apex. Some other preparations may also be adapted to this kind of case; but upon the same principle they may be made of different forms, as the figure of the preparations may require: the pyramidal case has the advantage of a firm standing on so broad a basis.

Fig. 4. A glazed box case. This is made in all respects as a common box, with a rabbet struck on the edge for the reception of a glass front, which is to be confined in its situation by slips of paper pasted round the outside edge, and turned over into the rabbet, so as to cover the glass about a quarter of an inch: the inside of the case is to be lined with white paper, which, if previously damped, in the manner Printers do for printing on, may be pasted in very smoothly. The back should be so constructed as to take out, to

Plate IX

Fig. 1

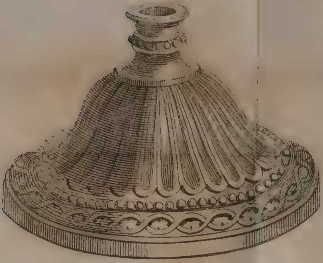


Fig. 2

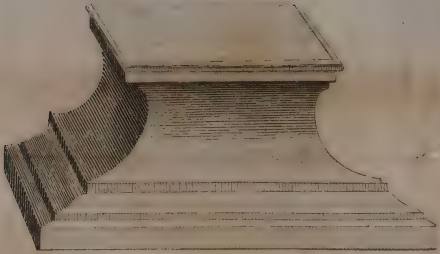


Fig. 3

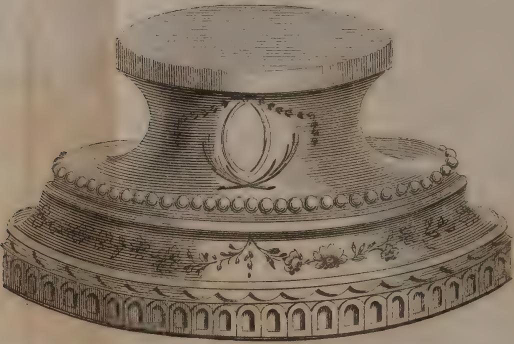


Fig. 4

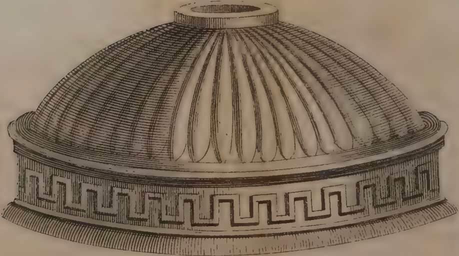
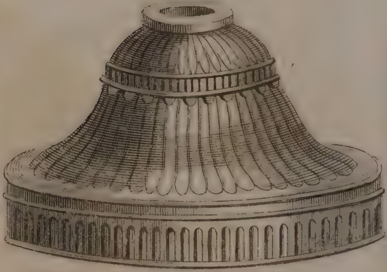


Fig. 5



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remove the preparation occasionally, or make any alteration in it: it is to be tacked in, and slips of paper pasted over the joints, to prevent the least dust getting in; and lastly, the outside should be blacked with lamp black, mixed with size, or a solution of isinglass: this case is adapted to stand on a shelf, or may be suspended on nails or hooks, by screw rings.

The form of these cases may be varied in length, breadth, or depth, according to the figure of the preparations they are intended to contain. Sometimes it may be necessary to have glass on both sides, to give a more complete view of the preparation; these may be called the double glazed cases.

The single glazed cases are the best adapted to placentæ, with the membranes preserved, or for any other hollow preparation of a similar nature; they should be fastened to the back-board, by two or three small tacks. The double glazed cases are convenient for corroded preparations, as both sides are wanted to be seen.

EXPLANATION OF PLATE IX.

Representing several Pedestals cast in Plaster of Paris, intended to support Corroded and many other Kinds of dried Preparations, and recommended as more consistent with their Elegance, than the common rude Masses of Plaster, upon which they have been hitherto generally placed.

Fig. 1. Is a small pattern adapted to corroded kidneys, &c.

Fig. 2. This is designed to support the models of heads, busts, &c. cast in Plaster of Paris, and for this purpose should be made large.

Fig. 3. Is adapted to support smaller models of the same kind, or of the extremities; also various injected parts, as the hand injected with quicksilver, hearts, &c.

Fig. 4. Is intended for the support of corroded livers, and other large preparations of that kind, as the kidneys, &c. of large quadrupeds.

Fig. 5. This is of an intermediate make, between Fig. 1 and Fig. 4; and may be used for corroded spleens, lungs, kidneys, &c.

EXPLANATION OF PLATE X.

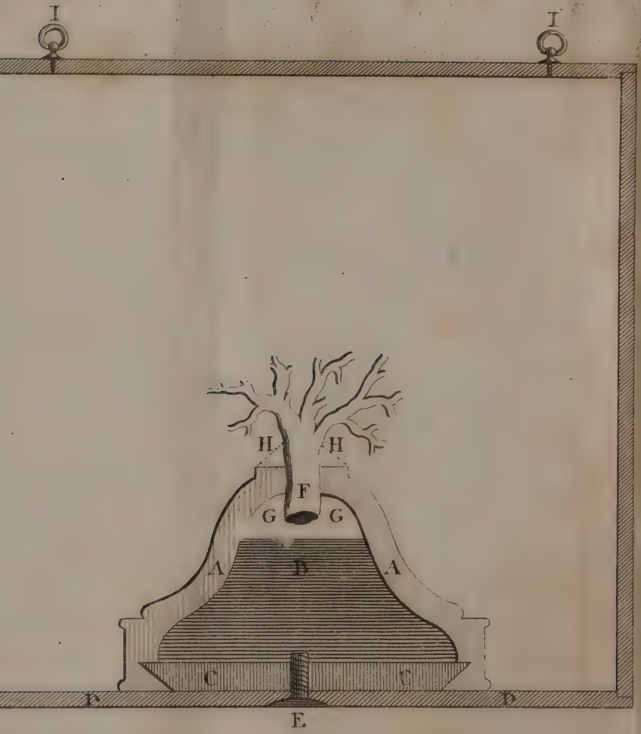
Representing a perpendicular Section of a Glazed Case and Plaster Pedestal, to shew the Manner of fixing in Corroded Preparations, and fastening the Pedestal to the Case to secure it from Accidents.

AA. The edges of the divided pedestal, shewing its thickness.

B. A hollow which always remains when the mould is not filled with the plaster.

CC. A circular piece of thin board, with its edges sloped off, and fitted into the bottom of the pedestal

Plate X



after it is made, in which situation it is confined by filling up, with Plaster of Paris, the groove, formed by the sloping edge of the board and the bottom of the pedestal.

D D. The bottom of the case upon which the pedestal stands.

E. A screw which passes upward through the bottom of the case into the board fixed in the pedestal, by which it is securely kept in its situation.

F. The trunk of a blood-vessel planted in the top of the pedestal, by means of an aperture made for its reception; and further secured in this situation by an addition of plaster (G G) on the inside, surrounding its large extremity: also on the top, so placed as to ascend obliquely to the trunk of the vessel, H H.

I I. Two picture-frame rings screwed into the top of the case, to suspend it upon two nails.

ARTICLE IV.

Of preserving Urinary Calculi and other Concretions.

THE nature of Calculi admits of no great variety in the method of preservation; such as are large should be kept in a box of cotton, or under glass covers, to defend them from injury, which they are very liable to by falls, and even handling, especially if their texture is soft, as is frequently the case. In order to shew the laminated structure, and the progressive increase from the nucleus, they may be divided by a fine saw through the middle, and the two surfaces polished; or as a substitute for the true polish, may be varnished by mucilage of gum arabic, and, when dry, with spirituous copal varnish. Biliary concretions being generally small, should be stuck upon slips of card, with a little glue, or mucilage of gum arabic, and preserved in glass vessels; if there are a large number of them, they should be placed in proper order on a piece of fine pasteboard of sufficient size, and then bent round the inside of a glass jar, with the concretions next to the glass. The pasteboard should be coloured, if necessary, to make a contrast, in order to exhibit them to better advantage.

ARTICLE V.

Of rendering solid Bones flexible and transparent.

FOR this purpose take a recent bone from any animal, and before it has become at all dried, macerate it in water for several weeks, to perfectly extract the blood; then cleanse it from all the surrounding fleshy, or membranous parts, and put it in a vessel of acid liquor, made by adding three drachms of muriatic acid to one quart of water; the vessel should be adapted to the size and figure of the bone, that it may be entirely covered with the liquor; and that there may not be so large a surface for evaporation. In this liquor it is to remain for three, six, or nine months, according to its solidity and thickness: the acid is to be renewed from time to time, as it becomes absorbed by the earthy part of the bone, and frequently stirred to mix the acid with the water. When the bone is become perfectly soft and flexible, remove it from the acid, and lay it in fresh clean water for a day or two; then suspend it in a current of air, and when completely dried, and put into a glass vessel of fine oil of turpentine, it will immediately, upon the oil penetrating the pores of the bone, assume a beautiful transparency, especially if it is thin, as a scapula or an ileum.

Bones thus rendered soft and flexible by the acid, may be tied in knots; or if broad and flat, may be rolled up like pasteboard, and put into narrow-mouthed vessels; they will afterwards, by their own elasticity, expand themselves and resume their natural figures: if they are preserved in spirits of wine without being dried, they will not appear transparent, but quite natural: this is sometimes done to puzzle persons not acquainted with the art, to account for the introduction of a bone through an aperture so much smaller than its diameter.

ARTICLE VI.

A Preparation to shew the Distribution of the Nerves.

For making a preparation to shew the distribution of the nerves, a small subject is more convenient than a large one, as it is easier to preserve it in spirits.

The dissection is begun by an incision through the cutis, from the lower part of the forehead, over the summit of the head to the occiput, then turning the scalp on each side, in order to remove a circular portion of the cranium with a saw; then remove the brain, in doing which, the nerves are to be cut off close to this viscus, beginning with the first pair, and gradually proceeding to the tenth pair.

As the first pair, the olfactory, are too tender to be traced by dissection, the second pair, the optic, are to be shewn by making a section to remove the superior part of the orbit. This should be large enough to admit of shewing the distribution of the branches of the third, fourth, fifth, and sixth pair of nerves, which are contained within the orbit. When these branches have been traced, the remaining branches of the fifth pair may be dissected. These are the superior and inferior maxillary branches. By dividing the maxilla inferior at its symphysis, the branches of the inferior maxillary nerve may be traced, one of which passes to the tongue, and another enters the foramen near the angle of the lower jaw.

The portio dura of the seventh pair is next to be traced, by carefully raising the parotid gland, when it will be found passing out at the stylo-mastoid foramen.

The eighth pair is to be traced, with the intercostal nerves, from the basis of the skull into the thorax and abdomen, carefully dissecting all their branches.

The branches of the ninth and tenth pairs are easily traced to the different muscles which receive their ramifications.

To dissect the nerves that arise from the spinal marrow, begin with the first pair, and after tracing their several branches, proceed to the second pair, and dissect them in like manner; then to the third, and so on, following all the branches to their last ramifications.

In dissecting the cervical nerves, the branches, which form the Phrenic ought to be preserved, and the nerve traced to the diaphragm.

When the dissection is completed, the subject may be preserved in proof spirits.

Any person not well acquainted with the distribution of the nerves, may be greatly assisted by consulting Monro on that subject, or Winslow's System of Anatomy.

ARTICLE VII.

Of varnishing Anatomical Preparations.

THE intention of varnishing anatomical preparations is, in most instances, to defend them from the moisture of the air, without which they would soon become mouldy, and thereby in a short time lose their beauty and utility; also to defend them from the ravages of insects, which otherwise would abound in all anatomical museums: lastly, to increase the transparency of some preparations, whereby their vascularity, or other particular organization, may be better demonstrated.

Preparations have been hitherto generally varnished with the white spirit varnish of the shops: for hard inflexible preparations it may answer, such as bony and thick muscular parts, but is not so suitable for the thin and flexible, such as bladders, intestines, membranes, &c. on account of its friability; for some time after such preparations have been covered with this varnish, and happen to be the least bent or pressed with the finger, it immediately crumbles into a resinous kind of powder; thus the beauty of the preparation is spoiled by giving it a degree of opacity. There is a varnish incomparably superior to this for most anatomical purposes, sold in shops under the name of oil varnish; it gives a beautiful transparency to membranes, intestines, &c. is strong and inflexible when dry, and affords a much better defence from the humidity of the atmosphere, and from the destruction of insects: a preparation well varnished with it may at any time be washed with soap and water without injury. Preparations designed to be covered with this, or any other varnish, should be previously and carefully freed from all greasiness, as that in a very small degree will prevent its drying. Whatever varnish is used, it is necessary that it should be done over two or three times; if with spirit varnish, it is of consequence that the part is first thoroughly dried, as the least moisture will chemically decompose the varnish, by entering into union with the spirit, and separating the resinous body it contains; hence also a very disagreeable opaque covering to the preparation.

Varnish should always be laid on with a fine camel's-hair brush, about the size of a finger, or smaller, as occasion may require. And as we cannot apply the brush to the inside of many hollow preparations, such as bladders, intestines, hydatids, &c. the varnish should be poured into them; and after turning them about in all directions, till the whole surface is covered, it is to be poured out and drained as clean as possible, otherwise it will collect in the most depending parts.

Corroded preparations are varnished without the use of a brush; these should be held over a bason, and the varnish poured over them in all directions, until the surface becomes entirely covered; then suffer them to hang up over the bason to drain, attending them frequently to remove the drops of varnish collecting on the most depending extremities of the vessels. These preparations do not stand in so much need of varnishing as most others; and I have frequently omitted it without any disadvantage; though some Anatomists are of opinion, when it is properly done, it greatly increases their beauty.

ARTICLE VIII.

Of Preserving Dried Preparations from Destruction by Insects.

ANATOMISTS have sustained no inconsiderable loss in their museums by the rapacity of the insects, with which they will always abound; and unless some effectual means are taken to prevent them, will ruin the dried muscular and membranous preparations: this inconvenience may however be easily and effectually remedied.

Varnishing preparations of these kinds in the common way, is intended to protect them not only from the insects, but from the moisture of the atmosphere, which would otherwise occasion them to grow mouldy, and soon destroy their beauty and their texture: in respect to the latter, it will have a good effect, but against the former it will prove little or no defence; yet the varnish may be so prepared as to answer this purpose also, by the addition of corrosive sublimate of mercury finely powdered, in the proportion of about a quarter of an ounce to a pint, which may be used in any of the varnishes recommended in this work; but a still better and more effectual method is, to lay the recent preparation in sublimate water for about twenty-four hours before it is dried; after which it may be removed, and varnished agreeable to the rules laid down in the preceding Article. The sublimate water is made by dissolving finely powdered corrosive sublimate of mercury in water, in the proportion of one ounce to a gallon.

As the sublimate is intended to destroy the insects, it is probable white arsenic may answer the same purpose.

ARTICLE IX.

Of making Vegetable Skeletons.

VEGETABLE Skeletons are most commonly made of fruit leaves and pods; the mode of conducting this process, is to reduce their more tender parts to a pulpy state, by boiling, or putrefaction: boiling is the most expeditious and the most agreeable method; but in many instances, does not answer so well as putrefaction.

The most favourable fruits for this purpose are plumbs, peaches, pears, &c. such as have strong fibres ramifying through them from the stem or stone; but the burgamy pear is the best for this purpose: they should be chosen as free as possible from all blemishes; and some trees produce fruit much more favourable for this purpose than others, on account of the difference in the strength of their fibres. The first part of the process is to boil them till they are become soft, then remove the external part with a knife, taking care not to injure the stems; then break down their texture, by gently pressing them in all directions with the fingers; afterwards washing away the pulp from the fibres by the finger and thumb under water, beginning at a part the most remote from the stems, and where the fibres terminate in extremely fine points; so proceed round and round, gradually advancing toward the stems; the cores may or may not be preserved, as is most agreeable; after they have been thus washed from all the pulp, they may be suspended in clean water for a few days, when the fibres will appear more pulpy; they should be again washed as before with great care: being then thoroughly cleansed, they should be suspended in vessels of spirits of wine, diluted to one part of rectified spirits, and two of water, and properly enclosed.

Leaves are more readily and beautifully anatomized by putrefaction; they should be such as have strong fibres, as the ivy, currant, hazle, &c. and should be put in a pan of water for two or three months, and exposed to the rays of the sun to forward putrefaction; the water should not be changed, but the pan filled up from time to time with water, and the better if from some stagnant putrid pond.

When putrefaction has rendered the pulpy parts soft, they may be gently beaten with the finger in the palm of the hand, till the external skins are loosened from the fibres, which ramify in a reticulated form between them; then remove the skins, and wash the fibres clean from the pulp, by continuing to gently beat them in the hand with clean water; when thoroughly cleansed, they should be dried between the leaves of a book, and afterwards fixed on some coloured paper, best adapted to shew their beauty by a contrast of colour.

The pod, or bladder, surrounding the Physalis Viscosa, or Winter Cherry, makes one of the most beautiful vegetable skeletons; they are made by putting them in a damp cellar, or some such place, till the more tender parts are decayed, and the fibres only remain, the pod is a pleasing form, and the fibres beautifully reticulated.

ARTICLE X.

Of improving old and injured Dry Preparations by Painting, &c.

THERE are many preparations kept in public anatomical museums, and in the hands of private surgeons, until they are greatly defaced by time and use, yet too rare and valuable to be discarded; the improvement of such must undoubtedly be a desirable object to us all. The injuries dry anatomical preparations sustain, are either from time, accidents, or the rapacity of insects, occasioning a loss of their proper colours, or of their substance: and although the improvement they receive from painting, varnishing, and otherwise repairing them, does not at all times make them equally good and valuable as when new, yet it is doubtless far better than to lose entirely such as are scarce and valuable.

Blood-vessel subjects, whether entire or separate parts, or any preparations of that nature, requiring cleansing and repairing, should first be soaked in lukewarm water for a few hours: it will be necessary to have it warm, by that means to soften the injection, which will prevent the vessels being so readily broken in the washing; then wash them with soap water, or some alkaline liquor, as soap-lees, working it into all the interstices with a common painter's brush; when they are thoroughly cleansed by repeated washings in this way, they should be laid in clean water for a few hours, to clear away all remains of the soap, and then may be hung up till perfectly dry; after which, the vessels may be painted of proper colours, with suitable sized camel's-hair pencils, and if carefully done, will look very well. These colours need only be mixed in the manner of common painter's colours. If once painting is not sufficient, they should be done over a second time; the muscles are sometimes discoloured, which may be remedied in the same way with proper colours. The paint should be thoroughly dried, and nothing more is necessary to complete the process, than to varnish them a sufficient number of times to give them a perfectly glossy covering; and this sometimes gives them a better appearance than they originally had. If there is a loss of any parts, either of the vessels or muscles, &c. they may be artificially supplied, if small, by glaizer's putty, or if larger, by wax, or something of that kind convenient for forming the natural figure of the part: but this should always be done previous to their being painted. Membranous preparations, when partially destroyed by insects, or otherwise, should be carefully cleansed by a dry brush, or by washing with soap-water, if they will admit of it, and the holes mended by pieces of bladder of suitable thickness; or some pieces of the same kind of membranes, cut to a proper shape and size, and fastened round the edges with a solution of gum arabic or isinglass, and when dry, the preparation should be varnished. If the part so destroyed had been injected, it may be made to resemble the original appearance, by delineating the vessels with a fine hair pencil on the part artificially supplied.

ARTICLE XI.

How to make Mineral White.

THE intention of this colour is to be used in injections, instead of Flake-White, and will be found to answer the purpose much better than any White heretofore sold in the shops.

The process is to be conducted in the following manner: — Saturate one pound of double aquafortis with clean lead cut into small pieces, then add to it gradually a solution of salt of tartar in water, as long as any effervescence appears; and when it has stood a quarter of an hour for the precipitate to subside, pour off the fluid from it, then fill up the vessel again with hot water, and stir up the precipitate from the bottom, which water is to be again poured off when the precipitate has subsided as before: this operation with the hot water should be repeated three or four times, to be certain of washing away all the saline matter; when the water may be more effectually separated by filtration, and lastly by evaporation; for which purpose it should be spread out upon a glazed dish, and exposed to the air, or a moderate degree of artificial heat. It should be observed, that none but vitrified vessels are to be used in this process.

This colour is prepared and sold by Frederick Smith, Chymist, in the *Hay-Market*, *London*, whose care and attention to the process may be confided in.

ARTICLE XII.

Of the Composition of Varnishes used for Anatomical Purposes.

THE best spirit varnish for varnishing corroded and other preparations is made of gum copal, in the following manner, and is called

SPIRITUOUS COPAL VARNISH.

Take of fine gum copal, reduced to a powder, and clean writing sand, of each one ounce; put them into a pint bottle, then pour in three ounces of the highest rectified spirits of wine, and continue constantly to shake them briskly together, until the gum loses its tenacity, and the sand will subside freely to the bottom, which, and the spirits assuming a yellow colour, is a sufficient criterion that the gum is dissolved and received by the spirits; then let it stand until it becomes fine and transparent, when it may be decanted off for use. The proportion of the gum may be varied as occasion may require.——This varnish is carefully prepared and sold by F. Smith, Chymist, in the *Hay-Market, London.*

OIL VARNISH, OR OIL COPAL VARNISH.

This is made by reducing fine gum copal to a powder, and liquifying it in a secure copper vessel over a well-regulated heat, then adding to it about two thirds of clean linseed-oil, and as much oil of turpentine as will reduce it to the consistence of a syrup. This varnish, if attempted to be made in a small quantity, will not be likely to succeed, and will be the better if kept twelve months before it is used. It should be remembered, that this is at all times a very difficult process, in which we are very uncertain of properly uniting the ingredients; and is dangerous in the extreme; so that an inexperienced adventurer may suffer much in the attempt to unite such inflammable ingredients in an highly heated state.

TURPENTINE VARNISH.

This is made by melting Venice turpentine over a gentle fire, and adding to it as much oil of turpentine as will reduce it to the consistence of a syrup, and stirring them well together. This and the oil copal varnish are sold in most oil shops of a tolerable quality.

AN APPENDAGE TO ARTICLE XIII.

To be read after Valves, in line 10, page 45.

AN accidental omission in the Article in respect to injecting the Coronary Vein of the Heart, has rendered this Appendage necessary, to describe the method of filling this vessel; which may be performed by making a small incision in the right auricle, through which the pipe is to be conveyed and introduced into the orifice of this vein; or the pipe may be conveyed through the incision made in the ventricle, as already mentioned, for the exit of the water in washing out the blood from the heart and veins. "The coronary vein "of the heart opens into the right auricle, between "the orifice of the cara inferior, and the passage "into the ventricle, and is furnished with a semi-"lunar valve, to prevent the blood from flowing "back:" This valve should be destroyed before the pipe can be properly introduced. After the injection of this vessel, the incision is to be closed by the twisted suture, or carefully sewed up.

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